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Roentgenological Study of Primary Lung Carcinomata

LLOYD BRYAN, M. D.
San Francisco, California

PRIMARY lung carcinoma is generally conceded to be rare, and on this account and because of the different types of picture which it may give, these nine cases are presented. No attempt has been made to include the histories or clinical examinations. The pathologist's reports are merely summarized, as the detailed pathological reports will shortly appear in a publication by Prof. G. Y. Rusk of the University of California who examined all these cases except Case No. 1, which was examined by Prof. Wm. Ophuls of the Stanford University.

In this series, there were five women and four men. The youngest, a woman, was 32 and the oldest, also a woman, was 63. Five of these cases were between 50 and 60 and two between 40 and 45.

In only one case, was occupation a possible etiological factor and that was in Case No. 8, a smelter.

One case was associated with lues and one with coccidioides of the opposite lung.

Both lungs were involved in five cases, the right lung only in three cases, and the left lung only in one case. The seat of the original lesion in three cases was in the middle lobe of the right lung, the base of the left lung in three cases, and the base of the right lung in two cases. The apices were involved in only two cases, and then only by extension late in the course of the process.

There were metastases to the pericardium resulting in fluid in the pericardial sac in three cases, to the liver in two cases, to the bones in one case, to the subdiaphragmatic lymph nodes in one case, to the cervical and axillary glands in one case, to the right kidney in one case, and to the wall of the ileum in one case.

Seven cases showed fluid in the pleural cavity at some stage. One case showed extensive breaking down of lung tissue with formation of multiple small abscesses.

The predominating symptoms were dyspnoea and cough following an acute febrile attack which had been diagnosed pneumonia. Pain was not a prominent nor an early symptom.

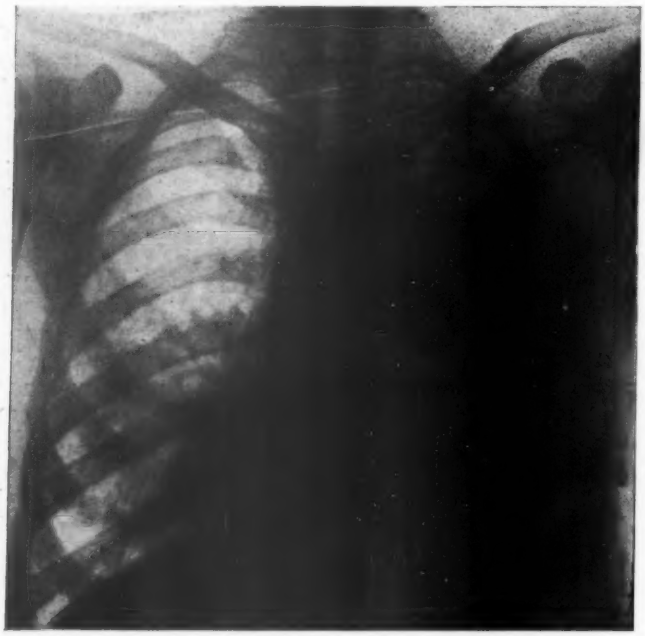
The roentgen diagnosis in this series was as follows:

Pneumonia unresolved. 1 case
Malignancy .....6 cases
Tuberculosis .....1 case
Pneumonia unresolved....1 case
Abscess .....1 case

The most common type in this series was the infiltrating showing a mass at the hilus or the extreme base, with radiations out along

the bronchial ramifications causing thickening of the peribronchial markings with a tendency for bead-like formations at the bifurcations and a hazy infiltration of the long tissues. Early, this may be difficult to distinguish from an inflammatory process as is sometimes seen following influenza, but repeated examinations will show the rapidly progressing nature of the process with marked extension out toward the periphery, causing marked increase in peribronchial thickening with only slight increase in lung field density. One case showed simply a dense tumor involving the entire left lung. Three cases were of the miliary type with large irregular mottled areas with indefinite borders which gradually faded out into the normal lung tissue. In one case, there was only a rounded discrete mass arising from the bronchus which showed no tendency to advance along the bronchi and no involvement of the lung fields and yet produced extensive bony metastases.

While the roentgen examination may be one of the greatest factors in establishing the diagnosis of this unusual condition, still there should be close correlation with the clinical examination. It has been stated that tuberculosis will rarely, if ever, be confused with primary carcinoma of the lung, yet in one of these cases, the pathologist reported a miliary tuberculosis from the gross specimen, and only a microscopical examination revealed the true nature of the disease.



J. D.—Case 1

Case No. 1—J. D. (m); aged 55; occupation, laborer and car repairer; referred by Dr. B. F. McElroy.

Roentgen examination shows a dense shadow involving practically the entire left chest. At the central portion of the left lung are small rounded discrete masses. At the central and lower portions of the right lung, there is rather marked fibrous thickening, with interlacing of the process extending out toward the periphery giving a network pattern. At the base, the process is more dense and seems confined about the course of the bronchi. The heart

D. H.—Case 2

shadow is obscured, but neither the heart nor the mediastinal contents are displaced.

Pathological examination showed carcinoma of the bronchus on the left side, metastatic carcinoma of both lungs, of the lymph glands of the neck, axilla, muscles of the chest wall to the liver and to the right kidney, and syphilitic changes in the aorta.

Case No. 2—D. H. (f); aged 45; occupation, seamstress. Dr. H. C. Moffit's Service University of California Hospital.

Roentgen examination shows irregular coarse mottling throughout both lung fields except at the apices, the left one of which is clear and the right one somewhat grey. Overlying the mottled areas is a somewhat uniform shadow of increased density. The heart and mediastinal contents are not displaced.

Pathological examination shows a gelatinous and caseous pneumonic process which is diffuse in both lung fields. Microscopic section of these areas proved them to be primary carcinoma of the lung.

Case No. 3—E. L. W., (f); aged 43; occupation, housewife. Referred by Dr. E. W. Willits.

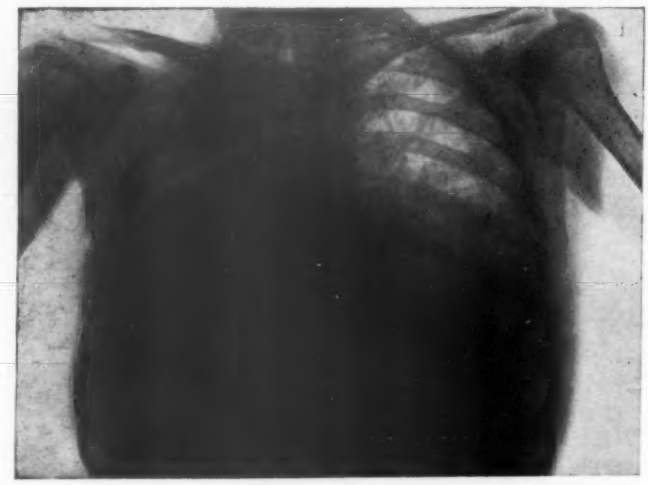
Roentgen examination shows a dense, rather homogeneous shadow involving the entire left lung except at the peripheral portion of the central region where

there is an area which is somewhat more radiable than the rest of the lung. Within this area can be seen small radiating areas of increased density. At the right base, there is a shadow of increased density extending well up into the axilla which has a definite sharply outlined medial border suggesting thickened pleura. The remainder of the right lung, except at the extreme top, shows rather marked peribronchial infiltration which extends well out to the periphery. There were numerous discrete nodules throughout both lungs. The pathologist's report on the gross specimen was miliary tuberculosis.

Section and miscroscopical examination showed this to be primary carcinoma.

Case No. 4—H. P. (f); aged 63; occupation, housewife. Dr. H. C. Moffit's Service University of California Hospital.

Examination shows rather marked scoliosis of the thoracic spine. Heart is slightly displaced



E. L. W.—Case 3

There is marked tendency for bead-like formation along the course of the bronchi, with irregular areas of coarse mottling scattered throughout the tissue between the bronchial markings. The trachea is displaced to the right.

Pathological examination showed fluid in the pleural cavity of both sides. The fluid from the left side was clear, and the fluid from the right side was blood stained. There was enlargement of the bronchial glands and both lungs were adherent to the chest wall, to the left. Rather marked enlargement of the bronchial root glands, particularly on the right side. In the first interspace anteriorly on the right, there is a small discrete nodule about .25 cm. in diameter lying close to the mediastinum. At the right base medially, there is an indefinite shadow of increased density, with rather marked peribronchial infiltration. In the right axilla, there is an oblong smooth mass apparently springing from the rib extending into the pleural cavity. There is also a destructive process

involving the upper lumbar vertebrae. The bodies of all the vertebrae are markedly decalcified.

Pathological report showed a nodule in the right lung near the spine medially about the size of a walnut which on section showed the tissue infiltrated by a firm, white growth occuring in irregular small interlocking foci. There was metastases to the sternum, to the third, fourth, fifth, and sixth ribs on the left side, to the lower

H. P.—Case 4

thoracic spine, and to the bones of the pelvis.

Conclusion: Primary carcinoma of the lung, with bone metastases.

Case No. 5—W. H., (m); aged 54; occupation, farmer. Dr. H. C. Moffitt's Service University of California Hospital.

Roentgen examination shows the upper two-thirds of the left chest infiltrated with rather coarse irregular mottling. These mottled areas are typical of those of tuberculosis. There is slight enlargement of the bronchial root glands from this side. The heart is small and central. At the right hilus, extending out into the lung fields, there is a fan-shaped, irregular, coarsely mottled area. In this area are rather large irregular areas of increased density without definite borders but gradually fading out into the lung tissue. There is considerable increase in peribronchial infiltration. The trachea is displaced slightly toward the right side.

A plate taken two months later shows practically no change in the process on the left side. The right side at this time shows a homogeneous area of increased density involving the entire right chest. The heart is displaced to the left and is enlarged.

Pathological examination showed a coccidoidal granuloma of the skin and lungs, with a small

cavity at the right upper lobe and of the left kidney. The central lobe of the right lung showed a primary carcinoma with metastases to the liver. The right pleural cavity filled with fluid.

Case No. 6—A. L., (m); aged 52; occupation, laborer. Referred by Dr. Max Rothschild.

Roentgen examination shows a rather homogeneous shadow of increased density involving the entire left lung. Underlying this shadow, there can be seen rather marked infiltration of the peribronchial tissue, which extends well out toward the periphery. At the right hilus and extending out into the lung fields, there is increase in peribronchial thickening, with rather coarse mottling of the lung fields between the areas of the bronchial thickening. In the right axilla, at the base, there is a homogeneous shadow of increased density and at the right cardio-hepatic angle, there is a rather dense irregular mottled area.

Pathological report showed primary carcinoma of the left lung, with metastases to the pericardium and to the right lung, with pleural and pericardial effusion.

Case No. 7—R. M., (f); aged 32; occupation, housewife. Referred by Dr. H. Allen and Dr. Grant Selfridge.

Roentgen examination shows an irregular area of increased density at the right hilus. Rather marked peribronchial infiltration of the right lung extending well out toward the periphery. Slight tendency for beading of this process, with rather fine mottling of the lung fields between the peribronchial infiltrated areas. There is thickening of the interlobar pleura between the middle and lower lobes on the right side. A similar infiltrated process extend-

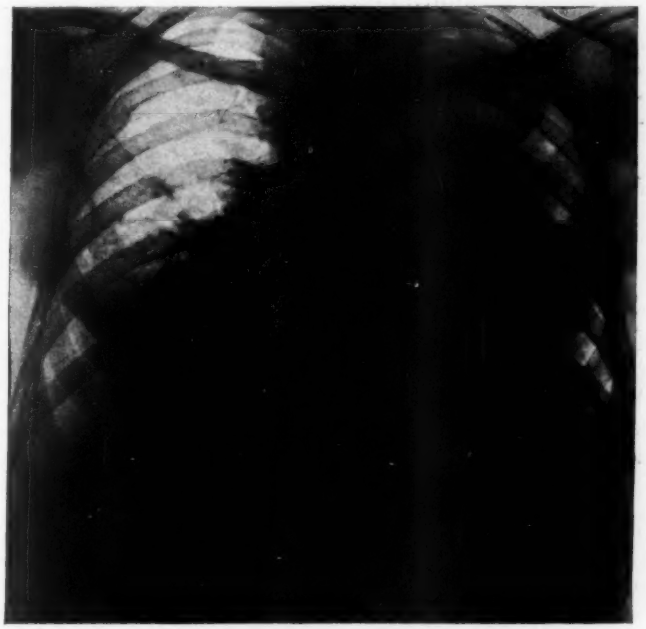
W. H.—Case 5

ing out along the bronchial markings, with slight mottling of the lung tissue is seen at the left side. Heart is rather markedly enlarged to the left, with prominence of the left border, and this enlargement extends well up on to the root of the vessels. It is globular in shape and broadens superiorly in the supine position, suggesting pericardial effusion.

A plate taken two months later after the pericardium had been tapped and markedly blood stained fluid withdrawn, shows a normal contour of the heart shadow. The infiltration process in the lungs had extended more toward the periphery and except for slight increase in density at the right hilus and toward the right base, the character of the lesion remained the same; that is, infiltration of the peribronchial tissues, with beading and fine mottling in the lung tissues.

Pathological report showed primary carcinoma of the right lung, with extensions into the mediastinal and subdiaphragmatic lymph nodes, metastasis to the left lung and to the pleura on both sides and to the pericardium.

Note: It is of interest that while the pericardium was tapped some two months before the patient's death, there was no recurrence of the fluid in the pericardium, although at autopsy, the pericardium was studded with multiple small carcinomatous nodules.



A. L.—Case 6

Case No. 8—L. F., (m); aged 53; occupation, smelter. Dr. H. C. Moffitt's Service University of California Hospital.

Roentgen examination shows an irregularly outlined shadow of increased density at the right hilus which extended rather markedly toward the right base. There was slight increase in density of the central portion of the right lung.

Within this area, there were irregular small multiple areas with indefinite borders which fade out into normal lung. There was rather marked enlargement of the root glands at the left hilus, with slight increase in peribronchial infiltration toward the left top.

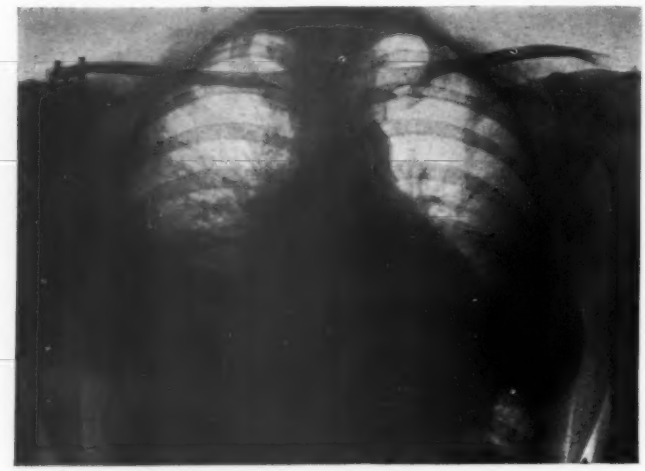
One month later, the lower two-thirds of the right chest was filled with rather homogeneous shadow of increased density. Heart was not displaced.

Pathological report showed primary carcinoma of the right lung, with extensive local infiltration throughout the mediastinum and about the pleural surface, invasion of the mediastinal lymph nodes to slight extent only, hemorrhagic exudate in the pericardium, and encysted fibrinopurulent pleurisy with secondary abscess in the mediastinum. The growth appears to originate in the bronchi near the root of the right lung.

Case No. 9—T. L. F., (f); aged 59; occupation, housewife. Referred by Dr. George Ebright.

Roentgen examination shows an irregular shadow of increased density at the left base, which extends higher medially than laterally. Underlying this shadow can be seen rather marked interlacing of infiltrated peribronchial tissue with coarse irregular mottling of the lung fields. There is rather irregular oblong shadow extending from the pleura into the thoracic cavity from the level of the seventh rib posteriorly to the apex. The heart is slightly displaced to the right.

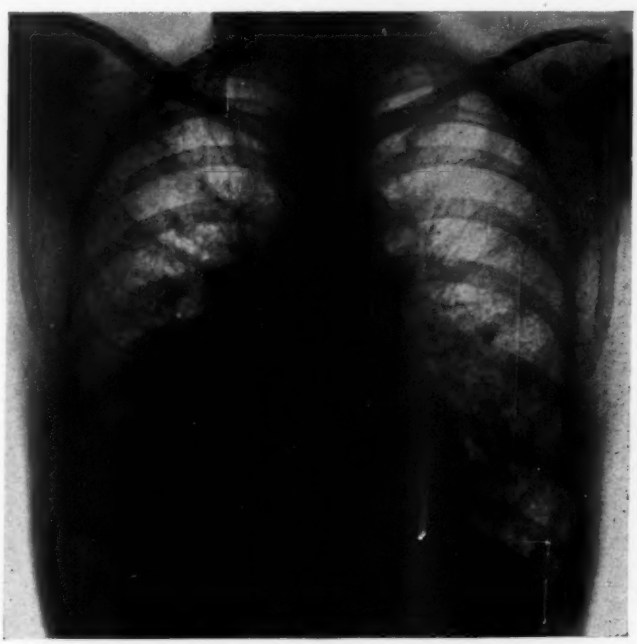
One month later, this shadow at the left base increased in size both superiorly and laterally. Also, the shadow at the apex and lateral portions of the left thorax extended rather markedly into the thoracic cavity. At this time, a considerable amount of clear, straw-colored fluid was aspirated. The heart and the mediastinal contents were displaced rather markedly to the right. At the insistence of the family of the patient, the thorax was opened and a small amount of tissue at the left base was removed for examination.



R. M.—Case 7
Figure 1—NOTE—One month between figures 1 and 2. and one month between figures 2 and 3.

The pathologist's report was carcinoma of the lung, probably primary. The general picture of cell type suggests more a growth originating from the lung tissue than one arising in the mesothelium.

I am deeply indebted to the physicians with whom I had the opportunity of seeing these cases and to Dr. G. Y. Rusk, and Dr. Wm. Ophuls who have so kindly furnished the pathological reports.



R. M.—Case 7—Figure 2

Discussion on Papers of Drs. Bryan and Carman

DR. FRANK BISSELL, Minneapolis, Minn.: My only excuse for discussing these two very interesting papers is that I have been placed on the program for that purpose. I have nothing to contribute. The slides and the paper by Dr. Bryan seem to be rather convincing proof that if a diagnosis of primary carcinoma of the lung is to be made it must be at the autopsy. In my own practice I recall but one case of primary carcinoma of the lung which was correctly diagnosed at least as carcinoma; and since there was but one nodule present and since nothing else was found at autopsy, it must have been a primary carcinoma of the lung. It must be a rare condition.

One point came to my mind as I observed these slides. Someone several years ago in discussing this subject, made the statement that a thickening of the interlobar pleura was a diagnostic sign of carcinoma of the lung. I have forgotten who made the statement, but it was a very positive one and he showed a number of slides to confirm his theory. I began looking more diligently for that indication and found it of considerable frequency, so I am convinced that it is not a reliable sign of cancer. The point brought out by Dr. Carman of the necessity of a pathologic examination of these miliary carcinomatous nodules to differentiate them from tuberculosis is very important.

Both essayists are to be congratulated upon the excellent presentations they have made.

DR. PERCY BROWN, Boston, Mass.: I have had very little experi-

ence in this subject. The radiographs which were shown by Dr. Carman are very interesting and very striking. The difficulties, it would seem to me, would be where a double lesion existed, one of which he showed, which might be a metastatic carcinoma and tuberculosis. The skill with which he has apparently made the differential diagnosis between what he calls the nodular type, which is the most difficult, and tuberculosis is very striking in that so many of the differential points of these conditions are quite rare. I regret that I did not come early enough to hear the first paper. I am, therefore, incapable of discussing it.

DR. GEORGE E. PFAHLER, Philadelphia, Pa.: I am not sure that I have not at some time made the statement that sarcoma, beginning in the mediastinum or along the root of the lung, tends to extend outward along the septum between the middle and upper lobes of the right lung. I have seen at least four such cases and have followed them up until they died, which means that the whole of that right lung gradually became solid with this sarcoma. I have no doubt about the diagnosis. My experience

R. M.—Case 7—Figure 3

DR. A. F. TYLER, Omaha: I would like to ask Dr. Carman a question. He made the statement in his paper that the infiltrating type of carcinoma extending out from the mediastinum along the bronchi was very rare if at all present. In the last year and a half I have had ten different cases come to me for post-operative treatment following amputation of the breast for carcinoma in which this type of infiltration was present, gradually extending out and involving the entire lung on one side and part of the lung on the other. I would like to ask the Doctor what that is if it is not the infiltrative type of carcinoma.

is the same as Dr. Tyler's and I have been able to follow these cases over a period of more than three years and some have come to autopsy. I cannot quite see how the experience that Dr. Carman has had, which is so very extensive, should differ so widely from our experience. Surely carcinoma must be the same in Philadelphia as in Rochester. If I had only seen these patients once and then forgotten them, I would not feel so sure about what I am saying, but they came to me for treatment of this

condition which I recognized and which I treated.

Dr. Bloodgood said he had not seen any improvement in mediastinal carcinoma. I have, but I have not seen any get well. I have seen mediastinal carcinoma appear, then gradually increase in size, and fill up the lung, so the patient could do nothing but sit up. I have only seen four cases, of primary carcinoma of the lung. One case examined and treated by me was referred to me by Dr. Jacques. The diagnosis was made because the patient, who was a doctor, coughed up a part of the tumor and had sense enough to take it to a pathologist for examination. He got an almost complete disappearance of the tumor but later the patient died of some pulmonary condition; I presume of carcinoma. He would not permit Dr. Jacques or anybody to make an examination, so we do not know exactly what he died from.

DR. A. C. CHRISTIE, Washington, D. C.: We get the idea that primary carcinoma of the lung is a rare disease. Dr. Bryan's paper would show that it is not so uncommon. I think it is often a very difficult disease in which to make a differential diagnosis. I have had two cases within the last year that have impressed this upon me very strongly. In both of them there was a homogeneous infiltration in the upper lobe of one lung. We thought it was primary carcinoma and we followed these cases over several months, in which there was a gradual increase in the area involved until nearly the whole upper lobe of the right lung was involved in each case. The first one ran a temperature during all this peiod and finally died. Although we never found tubercle bacilli in the sputum we believe he died of a caseous pneumonia. The second case followed almost the same course, but he is still alive. We found tubercle bacilli in his sputum and we feel sure it is a case of caseous pneumonia.

L. F.—Case 8
Figure 1—NOTE—Two weeks between figures 1 and 2.

DR. LLOYD BRYAN, San Francisco (closing his part of the discussion): In regard to the diagnosis of primary carcinoma, I admit it is extremely difficult at times, but I am very glad to hear Dr. Christie remark that the finding was not very uncommon. We have a number of other cases which I did not report because we did not have complete autopsy findings on them. We had one more

case in which we had complete autopsy finding. We had one more case in which we had complete findings in which the plates were negative.

Last week in Portland Dr. Watkins of Phoeniz presented six cases of primary carcinoma of the lung. While this is fairly uncommon we should keep it in mind all the time. We should watch these cases so we may get enough data to enable us to diagnose these cases ealy.

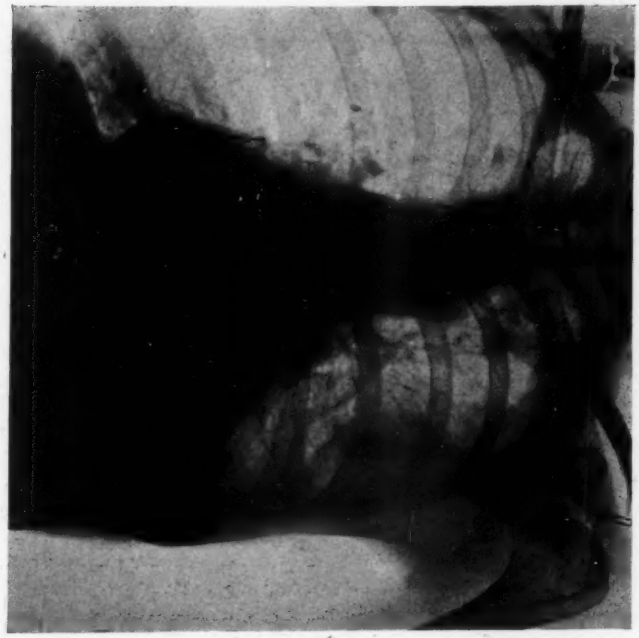
DR. TYLER: One case showed mediastinal infiltration and then later the spot in the lung gradually enlarged.

DR. CARMAN: My reason for going into this infiltrating type was because I felt as Dr. Pfahler does, that there was no difference in carcinoma in Philadelphia, New York or Rochester. Just before coming east I visited Dr. Robertson at Minneapolis and went over this question with him.

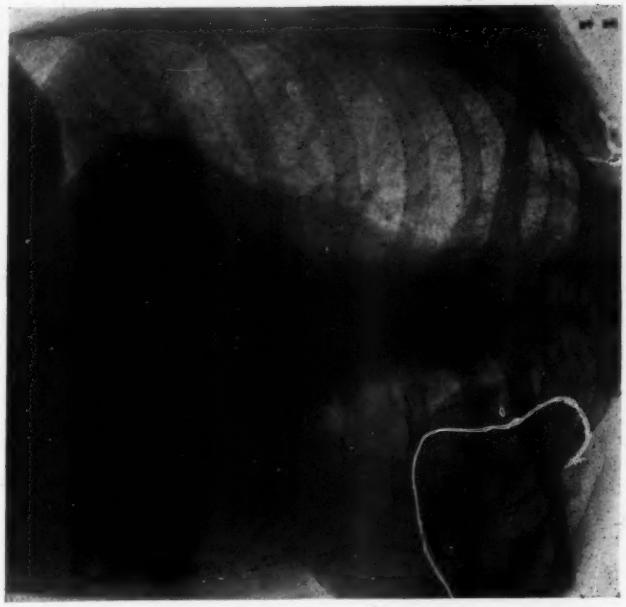
L. P.—Case 8—Figure 2

Regarding interlobar pleurisy, Dr. Hickey told me that all his cases showed thickening of the interlobar pleura. Only three of our cases showed this condition.

DR. RUSSELL CARMAN, Rochester, Minn., (closing his part of the discussion): Before answering Dr. Tyler's question, I would like to ask him if he was sure these were not pleural cases rather than mediastinal. He said this type could occur but it was very infrequent. Last Tuesday I visited Bellevue Hospital in New York and called on Dr. Symmers and went over the question with him. He agreed that it was very rare to see this type in malignant metastasis. In our series of 267 proven cases there was no single case that showed this infiltration. We do see infiltration in primary malignancy of the lungs.



T. L. F.—Case 9
Figure 1—NOTE—One month between figures 1 and 2.



T. L. F.—Case 9—Figure 2

*—Read at the Mid-Summer Meeting of The Radiological Society of North America, held at Boston June 3rd and 4th, 1921.

Means of Measuring or Specifying the X-Ray Dose Given

N. Ernest Dorsey, Ph. D.
Washington, D. C.

BEFORE taking up the question of the measuement or specification of the x-ray dose given, it is desirable to consider in some detail what we mean by dose. By doing so we will in some measure avoid the perplexity and misunderstanding that might otherwise arise from the fact that the word dose has, unfortunately, been used to denote several quite different quantities. Quantities, which it seems to me, it is most desirable to keep distinct.

The Dose

Turning to Murray's Dictionary of the English Language we find that dose is defined as "A definite quantity of a medicine or drug given or prescribed to be given at one time." This is the primary definition of the word, and I believe, it is the one that is universally used when applied to an actual medicine or drug.

Some of the medicine may be eliminated unchanged,, the remainder may be distributed very unequally among the various types of tissue, being much more concenrtated in some than in others, and only a portion of it will be expended in producing the therapeutic effect primarily desired. This distribution and the efficiency with which the medicine acts may depend upon the manner of administration. Nevertheless, the word dose is used to denote simply the amount of a specified medicine that is administered to the patient in a certain manner.

Related Problems

It is of much scientific interest, and often of great practical importance to know in what way the medicine is distributed throughout the system, to know how much of it is appropriated by a particular tissue, to know the manner in which it reacts with the tissue, and to know the net efficiency with which it acts, that is, to know what proportion of the amount that is taken up by the tissue is actually effective in producing the changes desired—the remainder being expended in producing changes of other kinds. All of these mattesr are of im portance and are included in the field of biological research: among biologists I class the physician and the surgeon.

As a result of such investigation it may be found that only a small portion of the material ad ministered is actually effective; nevertheless, the word dose will still be used to denote the amount that is given to the patient.

Applications

This does not mean that such investigations are of no practical value. Far from it. They throw light upon the manner in which the medicine acts, they help to explain unusual reactions, they may indicate the advisability of using a dose of a different kind or of administering it in a different manner. They are of great value in deciding what dose shall be prescribed, but they have nothing to do with the means of measuring or specifying that dose. However, the dose may be changed as the result of such investigations, it is the amount that is given to the patient in a specified manner.

This is as it should be. It accords with the ironclad rule of every careful experimenter, that what is actually done and observed must be kept plainly distinct from what is deduced, inferred, or calculated. The former are facts not open to discussion, while the latter should be carefully scrutinized and criticised by all, and may well require numerous changes as our knowledge increases. When they are kept distinct, the records of the former are of permanent value; when they are confused or when the latter only are given, the record is of but temporary, or even of doubtful value, it is essentially incomplete.

The use of the word dose to denote the amount of an agent that either is given to or is utilized in a particular way by a specific portion of tissue, as distinguished from the amount that is delivered to the patient, is discordant with the long established meaning of this word and so tends to confusion. In addition, it involves the tacit assumption that the amount that is concurrently received by other tissues or utilized in other ways is of no significance. This assumption is a serious one; no matter how sound it may today appear to be, investigations of tomorrow may prove it to be invalid.

The Unfiltered X-Ray Dose

The dose of a drug can be specified very simply; such a quantity (by weight or volume) of a specified drug is to be given in a certain way and at specified intervals. But when a physical agent, such as x-rays, is employed, the specification is not so simple; a greater number of physical factors have to be specified if the dose is to be completely determined.

Physical Factors

A beam of x rays consists of numerous trains of waves proceeding from the target of the x-ray tube. These waves are of exactly the same nature as those that produce in us the sensation of light. Like all other trains of waves, at least two quantities are required in order to specify the effects they can produce at any point. They are (17) the average amount of energy that the waves bring up to the point in a given time, and (2) the wave-length, or frequency of the waves. The first, the rate at which the waves bring energy to the point (not the speed with which energy is carried but the total amount that is brought up per unit of time), may be regarded as a measure of the quantity of x-rays that reaches the point in a unit of time: it corresponds exactly to the intensity or brightness of a light and is appropriately called the **intensity** of the x rays at this point. The second, the wave-length, may be regarded as determining the **quality** of the radiation; in the case of light, differences in wave-length determine the differences in color. The essential difference between light and x-rays is the difference in wave-length, the waves of light are over a thousand times as long as those of the x-rays that are commonly used. It is common knowledge that the effects produced by light vary with the wave-length, or color, of the light, and that this variation is determined by the material upon which the light acts. Ordinary photographic plates are insensitive to red light, certain others are quite sensitive to it. Similarly we should expect the effect of x rays to vary with their wave length, and that the extent and the nature of this variation will depend

upon the nature of the material upon which the effect is produced. But in advance of experiment we are not justified in making any forecast regarding the extent of this variation in any specific case; it may be negligently small, or it may be very great.

One phenomenon depending upon the wave-length of the incident x-rays, the emission of characteristic radiation, has been carefully studied, and we are now able to speak with confidence regarding this emission. But of the chemical effects produced by x-rays, and the manner in which these effects vary with the wave-length we know but little. Until this field is well explored the biologist will do well to bear in mind the possibility that these effects may depend upon the wave-length.

The total quantity of x-rays given to the patient will depend not only upon the intensity of the rays but also upon the **duration** of the exposure and upon the size of the **area** exposed. The effect produced will depend upon the particular portions of tissue that are permeated by the rays.

The physical factors that have to be fixed in order to specify the dose completely are (1) the intensity of the radiation, (2) its quality, (3) the duration of exposure, (4) area exposed, and (5) the tissues that receive the radiation.

Factors of Record

What observed factors should be recorded in order to ensure the complete specification of the dose? The duration of exposure and the size of the exposed area can be readily determined and recorded. The tissues that receive the radiation will be fully specified if, in addition to the size of the exposed area, its position, and the shape and direction of the beam of rays are known. The last two will be known if the distance and direction of the focus from the center of the exposed area are known. These also serve to fix the quantity and the quality of the radiation reaching any portion of the patient, when the intensity and quality of the radiation reaching the surface is known. There remains to be determined only the intensity and the quality of the rays that reach the surface. How can these be definitely specified?

In the research laboratory homogeneous radiations, radiations in which all the waves are of the same length, can be obtained and measured by various laboratory methods. In daily practice this is impossible. In practice you use one of a very limited number of methods, and you use the radiation that you thus get, modified to a greater or less extent by the interposition of filters. This radiation is not homogeneous and often is very heterogenous. An exact specification of the distribution of the energy among the several wave-lengths can be made only after an elaborte investigation, an investigation that it is practically impossible for the practitioner to make. He is thus thrown back upon indirect means for specifying the equivalent quality and the quantity of the radiation administered.

This indirect means is found in the conditions controlling the production of the radiations. Tubes of the same type, excited by the same means, to the same voltage, and carrying the same current will emit radiations of the same kind and intensity. Here is found the practical method for specifying these factors. State the type of tube used, the means used for exciting it, the voltage or

spark gap at which the tube is run and the current that passes through the tube. Subsidiary investigations of a purely physical nature will determine the intensity and the wave-lengths of the radiations that are emitted under these conditions.

Such subsidiary studies of the Coolidge tube when excited by a constant voltage, and when excited by the interrupterless machine with rotating commutator have already been made. These studies should be extended to other kinds of excitation. Until this is done a completely satisfactory interlocking of the results obtained with different tubes and different kinds of excitation will not be possible; but an approximate interlocking, at least insofar as the more pronounced effects are concerned, can be obtained by a less elaborate investigation, such as the photographic studies carried out by Dr. Shearer[1], and the ionization measurements described by Krönig and Friedrich.[2]

The facts that must be recorded in order to specify completely the unfiltered x-ray dose are (1) the means used for exciting the tube, (2) the type of tube, (3) the voltage applied to the tube, or the spark gap, (4) the current through the tube, (5) the distance from the focus to the skin, (6) the duration of the exposure, (7) the size of the exposed area, (8) the position of this area of the ray passing through its center. If the patient is exposed to radiation that is scattered from extraneous bodies this must be considered also.

Significance of the Several Factors

Although it is readily seen that the factors enumerated in the preceding paragraph serve to fix the dose quite definitely, the significance of the several factors is not always appreciated. A knowledge of the means used for exciting the tube is of importance because it determines in large measure, frequently completely, whether the voltage that is applied to the tube remains constant or varies, and how it varies. In this way it exerts a marked influence upon the quality of the radiation emitted.

The type of tube is important for several reasons. The efficiency of production; i. e., the intensity of the radiation that is emitted under specified electrical conditions, varies from one type of tube to another. In general the quality of the radiation that is emitted depends in part upon the material of which the target is made. The nature of the discharge through the tube depends upon the type of tube, and may markedly modify the periodical variation in the voltage across the tube, thus affecting the quality of the radiation. Hence unless both the means for exciting the tube and the type of tube used are known, the other electrical conditions will not serve to determine unambiguously the quality and the intensity of the radiation emitted.

The voltage applied to the tube determines the velocity of the cathode particles and in this way the quality of the emitted radiation. This radiation is never homogeneous even when the voltage is a steady, constant one. Increasing the voltage increases the intensity of all the radiations that were emitted at the lower voltage and adds to them new radiations of shorter wave-lengths. Usually the voltage applied to the tube is not constant, but varies over a certain range, and the radiation that is emitted is a mixture of the heterogeneous radiations corres-

ponding to the several voltages. Only a single value of the voltage is actually measured. The spark-gap measures the maximum value of the voltage, the kilovoltmeters that come with the apparatus are usually calibrated to read either the maximum value of the voltage or what is known as the effective voltage; but other calibrations are not impossible. The particular voltage that you measure should be specified.

For definite voltage conditions, the current through the tube determines the intensity of the radiation. If you double the current you double the intensity.

The radiation proceeds from the focus in straight lines. The further you recede from the focus the larger the surface over which the radiation is spread; the intensity varies inversely as the square of the distance from the focus. The distance of the focus from the skin is required for the determination of the intensity of the radiation administered, and with the size and position of the area exposed determines the tissues that receive direct radiation.

When the intensity is given, the duration of exposure fixes the total quantity of radiation per unit of area that is delivered at the point considered. So long as the duration of exposure is short as compared with the time required for any of the biological responses to become significantly effective, it is probable that the resultant biological effect of the radiation will depend upon the duration of exposure only insofar as it determines the total quantity of radiation administered; i. e., other factors being the same, the effect will depend solely upon the product of the intensity by the duration. But when a biological response (e. g., a recuperative reaction) reaches a significant value before the exposure is completed it is to be expected that the duration of exposure will take on an added importance; in this case the effect produced, other things being the same, will not depend solely upon the product of the intensity by the duration, but also upon the values of the individual factors composing the product; a higher intensity for a shorter time will in this case not be biologically equivalent to a lower intensity for a longer time, even though the product of the intensity by the time is the same in both cases. For this reason it is desirable that the duration of exposure be explicitly stated.

The size of the area exposed is of significance from several points of view. It is the patient and not merely an isolated portion of pathologic tissue that is treated; other things being the same, the quantity of radiation administered to the patient is directly proportional to the size of the exposed area. In their passage through matter, x-rays are scattered, very much as light is scattered in its passage through milk glass. Consequently the interior of a mass of tissue traversed by x rays, as well as the tissues surrounding this mass, will receive radiation that has been scattered from other portions of tissue. Within certain limits, the amount of this scattered radiation reaching a given portion of tissue will depend upon and increase with the size of the exposed area.

In general the larger the exposed area the greater will be the amount of normal tissue that is exposed; the exposure of normal tissue should not be overlooked in the biological evaluation of the treatment.

Quantitative Results

Having completely specified the dose prescribed or given, it is very interesting and of much importance to know how to combine the various numerical factors involved so as to obtain (1) quantitative estimates of the fundamental physical factors involved, and (2) biologically invariant relations. By a biologically invariant relation I mean such a combination of various factors as serves by its numerical value to specify completely the biological reaction concerned, irrespective of the values of the individual factors involved; however, the values of the individual factors may vary, the biological effect remains unvaried so long as the value of the combination remains unchanged. Such an invariant, within certain limits, is the product of the tube current by the duration of exposure; within these limits, so long as the number of milliampere-minutes remains unchanged, other things being the same, the biological reaction remains unvaried however the individual values of the two factors may be changed.

These estimates and relations are not directly concerned with either the specification or the measurement of the dose, but rather with the correlation of different doses, and with the choice of the dose that shall be prescribed. They are, however, of such interest and importance that it is desirable to speak briefly of them in this connection.

The fundamental physical factors, other than those very readily determined, such as time, with which we are here concerned are the intensity of the radiation and its distribution among the several wave lengths. The latter can be completely determined only by an elaborate research carried out under the same electrical conditions as exist during the treatment; I doubt if complete data of this kind is available for any of the conditions that are met with in practice. On the other hand, the gross intensity of the radiation emitted by a tube when excited in a given manner and to a given potential is quite amenable to investigation, and has been determined for the Coolidge tube when excited by a constant potential, and also when excited by means of an interrupterless machine. It has been found that the gross intensity at any point is measured by the expression

$$\frac{iV^2}{D_2}$$

where i is the current (milliamperes), V is the maximum voltage (or spark gap), and D is the distance from the focus to the point at which the intensity is measured. This expression multiplied by the duration of exposure (t) measures the total x-ray energy per unit of area that is delivered at the point considered.

Other tubes and other modes of excitation that occur in practice should be similarly investigated. Also the way in which the emission from one tube excited in a given manner compares quantitatively with that from a tube of a different type, or from the same tube excited in a different manner should be compared. For example, we know that the intensity at a point of the radiation from a Coolidge tube excited at a constant voltage is measured by the expression just given; that is the intensity (I) is

$$I = K \frac{iV^2}{D^2}$$

where K is a constant deter-

mined by the efficiency of the tube under these conditions, and by the sizes of the units in which the various quantities are measured. Similarly, when the Coolidge tube is excited by an interrupterless machine the intensity is

$$I = K_1 \frac{iV^2}{D^2}$$

but unless the efficiency is the same as before, K_1 will differ from K. I do not recall any data that will suffice to determine the ratio of K_1 to K.

In order to determine the intensity of the radiation at a point within the tissues it is necessary to know the effective absorption and scattering produced by the tissues through which the radiations pass. These also must be determined by subsidiary investigations in which are used radiations that are excited under the same conditions as occur in practice. In applying the results of such investigations it should be remembered that the distribution among the several wave-lengths of the radiation that has been transmitted through any layer of tissue differs from the distribution that existed before such transmission.

Another quantity, which should by subsidiary investigations be related to the thickness and nature of the surrounding tissue and to the factors that determine the dose, is the ionization of the air within a small, thin walled chamber that is inserted within the tissues after the procedure of Krŏnig and Friedrich.[2] What this ionization measures is not the intensity of the x-rays that enter the chamber. The observed ionization is the sum of that resulting from the action upon the air of the entering x-rays, and of that caused by the action of those high speed electrons that are expelled from the walls of the chamber and, possibly, the surrounding tissue and enter the chamber. For a suitably constructed ionization chamber this sum may possibly be approximately proportional to the amount of x-ray energy that is absorbed per unit of volume by the neighboring tissues, but of this I am not entirely sure.

Whatever physical quantity this ionization may measure, the observations of Krŏnig and Friedrich indicate that, in as far as local biological effects are concerned, the ionization thus measured by them is a biological invariant for a given type of reaction. An invariant that holds for radiations of very widely different qualities.

Another biological invariant, one associated with the unfiltered radiation from the Coolidge tube excited by an interrupterless machine has been determined by Dr. MacKee.[3] Using small areas of approximately equal size and upon the arm, he has determined the invariant for the so-called "skin unit" or "epilating dose." He found that whenever he obtained this characteristic reaction by such means the quantity

$$\frac{itV}{D^2}$$

had the same value; viz., 9/16 or 0.563 when the current is expressed in milliamperes, the time in minutes, the spark-gap in inches, and the distance in inches.

This invariant does **not** indicate that the intensity of the radiation varies as V, and that the therapeutic effect is independent of V and, therefore, of the quality of the radiation, but that for this reaction under these conditions efficiency of the radiation de-

creases as V increases. This is at once seen when we compare this invariant with the expression that measures the total energy delivered per unit area. If we denote the latter by the letter e, and the invariant established by Dr. MacKee by the letter E, then we have

$$e = K_1 \frac{itV^2}{D^2}$$

$$E = \frac{itV}{D^2}$$

From which it is evident that

$$E = \frac{e}{VK_1}$$

That is, for this reaction the efficiency of the energy of the specific mixture of radiations so furnished is inversely proportional to the maximum voltage. If you double this voltage you must apply twice as much of the x-ray energy in order to get the same reaction. For radiations of a different quality, a different mixture, none of these relations will necessarily apply. This, however, does not minimize their practical value. The corresponding invariant for the other modes of excitation and tubes that are used in treatment, and the invariants for other biological reactions should be determined.

If with the same equipment the biological invariant is found to be the same (not necessarily to have the same value, but to be of the same form) for several kinds of biological reactions, then, and only then, will one be justified in regarding this "skin dose" as a suitable unit in which to express the dose employed for producing these reactions.

The Filtered X-Ray Dose

The introduction of a filter produces numerous changes in the radiation administered. The filter not only reduces the intensity of the radiation and profoundly changes the quality of the radiation by absorbing the longer waves more strongly than the shorter ones, but it may add to the radiation its own characteristic radiation. Also it scatters the radiation passing through it and thus acts as a secondary source of radiation, very much as ground glass scatters the light passing through it and thus becomes a secondary source of illumination. There are thus two sources of radiation to be considered (1) the focus of the tube, (2) the filter. The first is a point; the intensity of the radiation received directly from it by any point varies inversely as the square of the distance from the focus to that point. The second is an extended surface having an effective brightness depending upon its distance from the focus of the tube. Viewed perpendicularly, the intensity of the light received from an extended bright surface depends upon the brightness and the area of the surface and upon the distance of the observer from it. As the observer recedes from the surface the intensity decreases at first much less rapidly than the inverse square of the distance; the rate of decrease gradually approaches that of the inverse square of the distance and becomes equal to it when the observer has receded to a distance that is great as compared with the dimensions of the surface. Consequently the presence of the filter modifies the manner in which the resultant intensity varies with the distance from the focus; and the extent of this modification depends upon the distance of the filter from the focus and from the patient.

Hence when a filter is used, the specification of the dose should

contain, in addition to the factors considered in connection with the unfiltered dose, a statement of (1) the material of which the filter is made, (2) its thickness, or better its weight per square centimeter, (3) its distance from the focus of the tube, and (4) its area.

The gross energy carried by x-rays, emitted under practical conditions and filtered as for therapeutic use, should be determined; the effect of the filter as a secondary source of radiation should be studied, and biologically invariant relations should be determined.

In the determination of bio logical invariants for filtered radiations a beginning has been made by Dr. Schmitz.[4] In the April issue of your Journel he records values for an "erythema skin dose" obtained by him at three voltages, the focal distance and current being the same for all. The filter was of aluminum 10 mm. thick, the peak voltages varied from 108 kilovolts to 140 kilovolts (6.5 in. to 9.5 in.), a Coolidge tube excited by an interrupterless machine was used. These results, when corrected for a printer's error, indicate that for large values of D the invariant for the E. S. D. is

$$\frac{i\,t\,V^{4.7}}{D^2}$$

If D is not large, the denominator may be less than D^2 on account of the filter acting as a secondary source of radiation.

Summary

In the interest of consistency and precision confine the term "dose" to its original use to denote what is given to the patient.

Make use of such theories and subsidiary observations as may be available and applicable in deciding what dose shall be given.

Specify the dose by stating the various factors that determine the quality and quantity of the radiation that is administered to the patient.

Having thus specified the dose, interpret it in terms of such theories and subsidiary observations as may be available and apparently applicable to the case.

Care should be taken to keep the interpretation of the dose—its value in erythema dose, pastille reading, Krőnig and Friedrich's ionization unit, etc—dis tinct from the specification of the dose itself.

The physical characteristics of the various types of x-rays employed in therapy should be determined in terms of the instruments and the electrical quantities involved.

Additional biologically invariant relations between the electrical quantities should be determined.

*—Read at the Mid Annual Meeting of the Radiological Socity of North America, Boston, June 1921.

1—Shearer, J. S.: Amer. Jour. Roent genology, 1915. Larkin, L. P.: Amer. Jour. Roentgenology, 6:448, 1919.

2—Krőnig and Friedrich: Physikalische and biologische Grundlagen der Strahlentherspie.

3—MacKee, G. M.: Amer. Jour. Roentgenology, 6:602, 1919.

4—Schmitz, H.: Jour. Radiology, 2:55, 1921.

Discussion

DR. HENRY SCHMITZ, Chicago: The paper of Dr. Dorsey is certainly a highly scientific one. It is very interesting and important for therapeutists. There is not anything that Dr. Dorsey has said with which I should differ. There are various things we should keep in our minds. In the first place, as Dr. Coolidge has probably found out, we should remember the differentiation of dose. Dose is the amount absorbed. It is made up by the intensity of the x-ray current, the time duration and the application di-

vided by the volume. Now this volume is, of course, in our equations a unit and consists of 1 cc.; in other words, if I have these three factors, I know exactly what may happen in a 1 cc. dose. When the distance is increased from the focus conditions necessarily become entirely different, due to the absorption and radiation in the tissues; in other words, if we apply this to a carcinoma of the uterus it becomes necessary for us to determine the exact distance of the tumor area from the focus, the tube. We know under general conditions the skin is 35 cm. from the tube, but the cervix necessarily lies at least 10 cm. farther from the tube; that is, instead of being 35 cm. it is 45. We have made a great many measurements in women in order to determine the difference in the distance of the tube from the uterus. We found in the lean, small patients that the diameter from the posterior surface of the abdomen to the posterior skin surface averages about 16 cm. In these 16 cm. we estimate that the cervix usually lies 10 cm. beneath the anterior surface. Another patient will measure 18 and others 20 and 22, with a few exceptions above 22. We went about regardless of the results obtained by other methods, inserting the measuring chamber in the vagina. It was found that at the plane where the cervix was located, necessarily whatever the instrument measured at that point would be the dose that was given at this point of the cervix. We came to some very remarkable conclusions. If we used a voltage of 90,000, with 5 milliamperes of current, filtration 10 mm. of aluminum and 6 mm. of sole leather, a focal distance of 35 mm. from the skin surface and a diameter of 25 cm. we found that the intensity of the dose in the cervix through the anterior skin was about 30 per cent. on the average, sometimes 25 and sometimes 28. The posterior field is only 5 or 6 cm. beneath the skin and you have a difference of 50 per cent. of the skin dose, using a new machine. In patients who have a diameter of 20 cm. the result was more unfavorable. In patients having a diameter of 25 cm. the dose brought to the cervix was reduced to about 50 per cent., while in patients with a diameter of 20 cm. it was reduced about 40 per cent.

Now the question arises, what is the real cancer dose; what radiation must we use to get results? We once believed that carcinomatous tissue was twice as sensitive as normal skin; in other words, if you applied a skin dose under these conditions, then you were practically using the cancer dose at the skin. This was found out by considering superficial carcinomata. Take a cancer of the breast on the anterior chest wall, the depth is not very great, especially if it is not very extensive. Under these conditions it was found out that if you wished to bring about a decrease in size and an absolute disappearance of the cancer it required 90 per cent. of the skin dose. That does not mean that in each and every instance you could make the cancer recede. I do not wish to enter into a discussion on something on which we might find exceptions. If we applied the proper skin dose, we were still losing 10 per cent. of the skin dose under the most favorable conditions and 50 per cent. under unfavorable conditions. The question now arises, what is the skin dose? Unless we get an exact definition for skin dose and know how to obtain it, our results necessarily must vary and that is the one great question which we must answer. I will not dwell on this point. The methods that are based on ionization are the only methods in my opinion which will give us the solution of the problem. However, it would be entirely wrong to expect every therapeutist to use the ionization method in the determination of the dose. If we do exactly as Dr. Dorsey has told us, know exactly the voltage, know exactly the type of apparatus with which we are working, use always the same tube, the same filter, the same focus, same skin distance, and the same field, then the results which have been determined by the ionization method must always be the same. Unless we do this we will always get different results and we will always have failures, but if we follow out Dr. Dorsey's method in studying details in obtaining our dose, we will always be correct.

*--Read at the Mid-Summer Meeting of The Radiological Society of North America, held at Boston June 3rd and 4th, 1921.

Recent Developments in Deep Therapy Technique-Facts and Fancies

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WE think it has been proven beyond the shadow of a doubt that both x-ray and radium have a definite field of usefulness in the treatment of malignant growths. In the consideration of this subject, we want to try to come to a little clearer understanding about several things, viz., the objective for which we strive in using these agents in treating malignancy; second, the method of their action; third, the kind of cases suitable for this kind of treatment; fourth, the results which can be obtained in the various types; fifth, the essentials of proper technique.

The object of radiotherapy is fourfold as defined by Finzi (1). The first is to prevent dissemination. Due to the value of the rays in damming up the lymphatic channels and in rendering malignant cells incapable of reproduction, we are able to use these agents for this purpose. The second object in the use of this kind of therapy is to kill the growth in situ. The third is to render an inoperable case operable, and the fourth is to render the patient more comfortable in cases where they have been pronounced inoperable.

Method of Action

The action of the x-ray and radium in the treatment of malignancy depends almost entirely on the destruction of the growth. Destruction of the growth by these agents is in direct ratio to the power of reproduction of the cells in the growth. That is, the more rapidly the growth is growing, the more easily will it be affected by radiotherapy; so that cases which have been of long duration necessarily require more severe treatment than do those of recent origin. The histological effect of the exposure of the tissues to radiotherapy is shown by a direct action upon the capillaries in the growth. After exposure to radiant energy the endothelial lining of the small capillaries becomes badly swollen, increasing to such an extent that the lumen of the vessels becomes entirely obliterated, resulting, under proper treatment, in an endarteritis obliterans. Another action is that upon the cells of the growth itself. This is shown, first, by the effect on the nuclei. There is a dense, cloudy swelling of the nuclei with a little later a rupture of the nuclear membrane, followed in due course by cloudy swelling of the entire cell. Shortly after this, the cell itself disintegrates and disappears, probably being carried away by the phagocytes. The last cells in the growth to die are those supplied with the most abundant nourishment. This means that the nests of cells placed between the branches of arteries which are almost surrounded by a rich blood supply, are the last to yield up their vitality. It is from these cell nests which have not been destroyed by the treatment that we get our local recurrences. After destruction of the cells of the growth, we have them replaced by conective and fibrous tissue; so that the parenchyma of the growth is

destroyed and we have left behind a mass of scar tissue. Tissue which has thus been treated does not respond very well to later treatment, consequently, it is very important for us to administer sufficient treatment to completely destroy the growth at as early a date as possible after beginning the treatent. Previous treatment of a growth by means of caustics also renders the treatment by radiotherapy more difficult. It has been a matter of clinical observation that when infection is present in a malignant growth, treatment by radiotherapy seems to spread the disease instead of destroying it. This is due, in our opinion, to the fact that radiotherapy minimizes leukocytosis, breaking down the barrier which nature needs in combatting infection. Consequently, when a patient with a growth is presented for radiotherapy and which has infection present, it is necessary for us to rid the growth of the infection before we begin the treatment.

Due to the fact that malignant growths spread through the lymphatic channels, especially the carcinomas, it is only reasonable for us to use the same precaution in administering radiotherapy that the surgeon uses in his treatment, viz., that we should try to block off the danger of metastasis through the lymphatic channels. This can be done effectively by the application of radiotherapy to the growth itself in sufficient doses to kill it and at the same time administer a dose to all the surrounding lymphatic channels sufficient to cause their obliteration. Since lymphatic tissue responds rather easily to radiotherapy, this blocking off can be done without destruction of the superimposed skin. By this method of attack, one will find that the recurrences following radiotherapy in properly selected cases are reduced to the minimum.

The kind of case suitable for radiotherapy must be well estab lished so that we will not assume to do the impossible. We have divided these into three main classes: first, those in which radiotherapy is preferable, including epithelioma of the face and lip and certain types of mouth cancer, cancer of the cervix and lympho-sarcoma; second, those cases in which radiotherapy is optional, cancer of the tongue, cancer of the penis and cancer of the breast; third, those cases in which radiotherapy is the last resort, viz., in all inoperable cases of malignancy. There should be preoperative treatment in all malignancies and postoperative treatment in all cases.

Technique

During the earlier history of x-ray therapy, technique was largely a matter of individual experience and observation. Due to the type of apparatus which was employed there was no possibility of standardizing the technique. During the last few years, however, certain changes have been made in the mechanical methods of producing x-rays which lead us to think that standardization of technique will soon be an established fact. Mechanical changes which have been made are due to two important things; first, the invention of the so-called interrupterless transformer which gives us a constant unvarying output over long periods of time; second, the invention of the Coolidge tube which is so made that we can actually duplicate results day after day, producing the deep pene-

trating rays of certain definite quality of penetration and of certain definite volume. As early as 1914, I had realized the value of high voltage for producing x-rays, coupled up with heavy filtration, in order to shut out the rays which we did not desire to use. By this technique it is possible to get the maximum dose into the growth with the minimum amount of skin reaction. This technique proved so valuable in my hands that I have continued to use it constantly in all deep therapy. I soon found that it was possible by employing this technique to give doses which under other technique were unheard of and absolutely out of the question. In fact, my technique for the past seven years has been the employment of not less than a ten-inch spark gap, measured between two points, and not less than six millimeters of aluminum as filter.

Recent publicity given to the so-called advance in deep therapy, as outlined by the Germans, calls for reconsideration of the matter of deep therapy technique. Certain points which have been brought out by this publicity are extremely valuable while others have doubtful value. The valuable points are the fact that a small ionization chamber has been devised which can be introduced into the vagina or rectum during deep therapy of the pelvis, so we have a way of measuring the actual dosage which enters the tumor instead of measuring the dosage received by the skin and estimating the dosage received by the tumor. This little refinement in mechanical measurement of the quantity of x-rays received in the tumor makes it possible for us to definitely estimate the lethal dose for cancer cells. By estimating the lethal dose for cancer cells then the purpose of our treatment becomes more firmly fixed, viz., that we should try to kill all the cancer cells found in the patient's body. The second point of value that has been emphasized is the fact, which has long been proven by the biologist, that cancer cells are more easily affected at the first treatment than they are at later treatment; that is, after exposure to radiation the cells develop a certain amount of immunity. Theoretically then, we should attempt to administer the lethal dose to cancer cells at the first treatment. Whether it is possible to do this without overwhelming the patient's power of resistance and practically killing the patient on the table, is a question which is open to argument. We are inclined to think that in America we shall be compelled to give the single massive dose broken up into several short periods of treatment alternating with periods of rest, but the dosage being completed in a two or three day period.

Another advantage in the technique advocated by the German clinicians is the use of a greater anode skin distance. In America, it has been customary to use an average anode skin distance of nine inches, while the German average anode skin distance is thirty-five centimeters, or fourteen inches. (6) This means that the ratio of the dosage received by the skin and the tumor is considerably changed by employing a greater distance, so one can actually deliver a larger volume of x-rays to the tumor with less skin reaction than he can by using the closer distance. For instance, suppose that the tumor to be treated lies four inches below

the surface of the skin and we use an eight-inch anode skin distance, the total anode tumor distance would be twelve inches. Under the technique of using a fourteen-inch anode skin distance, the anode tumor distance would be eighteen inches. Using these two distances as illustrative of the difference in time required to get the same dosage into the tumor, we have the following formula: using the twelve-inch anode tumor distance as a unit one, and comparing it with the eighteen-inch anode-tumor distance, it will be found that it requires 2.25 as much time—all other factors being equal—to get the same dosage into the tumor at the greater distance than it does at the lesser distance. In order to estimate the difference in dosage received by the skin we would use the factors eight and fourteen. Since the quantity of rays varies inversely with the square of the distance we would have the following formula: $8^2=64$, $14^2=196$. .64 : .96 : : 1 : 3.06. This interpreted means that the skin dosage at the greater distance—all factors being the same, including time, would be approximately one-third of what it would be at the lesser anode skin distance; which would mean that we have a margin of safety of two-thirds which we could employ in giving additional dosage to the tumor, but since at the greater distance it requires 2.25 as much time to get the same dosage into the tumor we would actually have only a margin of .75 which could be used in getting additional dosage into the tumor. For the sake of simplicity we are disregarding the filtration of the rays by four inches of body tissue. When this is utilized through two or more ports of entry we can readily see how much greater dosage can actually be delivered to the tumor by the greater distance.

By using the greater anode skin distance, a larger port of entry can also be employed, so that the secondary rays generating in the tissues themselves will be considerably greater than when a smaller port of entry and a closer distance is used. To quote from Leonard B. Loeb (2): "We can then safely assume that the amount of chemical change produced in the tissues by the action of these radiations per cubic centimeter of tissue is directly proportional to the total number of ions produced in that cubic centimeter. And we may therefore at once proceed to compare the relative activities of the various types of agents on the basis of their ability to produce ions in a given number at a given place. In doing this I will first show how this number varies with the different factors entering into the exposure.

"1. The total number N of ions produced per unit volume depends on the number of ions formed per cubic centimeter per second I and on the number of seconds exposure T, i. e., $N = I \times T$. (This holds well within reasonable limits. Where exposure time becomes so long that elimination of reaction products by the body as well as marked physiological changes can take place this no longer holds, e. g., in comparison the action of gamma rays from 200 mg. of radium for one hour with that of 4 mg. of radium for 50 hours).

"2. The quantity I will vary directly with the quantity of radiation emitted by the source per unit time, i. e., I is proportional to the quantity Q. In other words, the ionization will depend directly on the quantity of radium used,

or on the milliamperage going through the x-ray tube.

"3. The quantity I will further depend on the total number of ions produced per second by the radiations per unit of radiating substance, or radiations, used. Thus we know that the $13.6X10^{10}$ alpha particles of radium produce $2.56X10^{16}$ ions per second, per gram of radium when absorbed. The beta particles produce $9X10^{14}$ ions per second while the gamma rays from one gram of radium produce $13X10^{14}$ ions. The total number of ions produced by the x-rays from a Coolidge tube operated at about 90,000 volts, with 10 milliamperes possibly yields about $4X10^{17}$ ions, assuming that the efficiency of the x-ray tube is 0.2 per cent in producing x-rays and that each electron in the tube giving a homogeneous x-ray pulse would in matter give $3.5X10^{3}$ ions. This is an assumption which so far has not been accurately checked experimentally. It is here that some physical work must be done in order to enable one to compare x-ray ionization more rigorously with the radium rays. The value of $3.5X10^{3}$ was found by Rutherford's pupils for slow beta rays whose velocity in order of magnitude with the number of ions to be expected from energy considerations. It is possible that the number of ions estimated above may be in error by a marked amount. This error will make the ionization higher than it really is by a factor which depends on the homogeneity of the rays, and which with the data before me I am unable to estimate.

"4. The number of ions per cubic centimeter per second formed in a given region will depend on the fraction of the total radiation from the Q units of radiation used which strikes the area considered. This fraction is determined directly from the solid angle subtended by the area in question at the source. It can be computed from the ratio of the area cut out of the surface of the sphere surrounding the radiating source at the place considered, by the cone whose apex is the radiating source and whose base is the area radiated, to the total surface of the sphere for the rays from radium, or to the hemisphere for the case of the x-rays. To a sufficiently close degree of approximation it is given by the area A of the region to be treated divided by $4\pi R^2$ for the radium rays, or $2\pi R^2$ for the x-rays, where R is the radius of the sphere, i. e., the distance of the area from the radiating source."

The filter employed in the German technique is not less than one-half millimeter of pure copper. This has the same filtering quality as twelve millimeters of aluminum. Of course this well cut out a larger percentage of the rays than will six millimeters of aluminum, so that in using the same spark gap we are now using we will be compelled to increase the time of treatment considerably in order to get the same volume of rays into the tissues. The research work done by Professor J. S. Shearer (9) has proven beyond the question of a doubt that increasing the filter without increasing the voltage to care for it cuts off a very large percentage of the rays emitted from the Coolidge tube. In fact, according to him, in no case would twelve millimeters transmit half as much as six millimeters; consequently, when we are continuing to employ the same voltage under the newer technique that has been previously employed with less filtration, you can readily see that

the time must be increased many fold. In fact, three millimeters of aluminum transmits 13 per cent. of the wave length .45 Å, while six millimeters of aluminum transmits only 2 1/3 per cent of wave length .45Å. We do not have the figures at hand but you can readily see from this that twelve millimeters would transmit a very small percentage of the same wave length. Theoretically, the technique suggested by the German clinicians has attempted to overcome this difficulty by employing a materially greater voltage. The facts in the case are, however, that the symmetrie outfit when operated according to the instruction of the manufacturer furnish only a parallel spark gap of twenty-four centimeters or what would be equivalent to 9.6 inches. The Veifa outfit, however, at its maximum output has a capacity of twelve and a half inch parallel spark gap. (3) measured between blunt points.

Professor Wm. Duane of Harvard (4) has proven that the product of the voltage applied to the x-ray tube into the wave-length of the shortest x-rays produced is constant and equivalent to 12,360. Since the shorter the wave-length the more penetrating the ray is, this law is the fundamental basis of the modern high tension, short wave-length x-ray therapy.

From this evidence we can readily perceive the folly of increasing the filtration to the extent of one-half millimeter of copper unless we increase the voltage to correspond. In other words, if we do this, we are simply fooling ourselves and are not getting the dosage which we think we are getting, but if one wishes to combat malignancy in a scientific manner by means of the newer technique, one cannot escape the importance of the facts mentioned above.

This accounts for the extremely long period of treatment employed by the Germans together with the fact that in America we ordinarily employ five milliamperes of current while the Germans use from one to two milliamperes. The difference in the quantity of rays passing through six millimeters of aluminum filter to the tumor and the quantity passing through a half millimeter copper filter accounts for a considerable amount of the difference in the time factor employed by the Germans as contrasted with that employed in America.

There is another factor, however, which enters into this time element. In America it is the common custom to employ five milliamperes of current into the tube while the Germans usually employ only one or two milliamperes of current. As you will see, this would increase the time factor five times if only one milliampere was used or two and one-half times if two milliamperes were used, all other factors being the same. This leads us to think that practically speaking, some Americans have been using the same dosage for a period of years that is now being heralded as something entirely new.

The points in the reported German technique which have been misleading are those in which they mention the enormous voltage and the amount of dosage used. It is not generally understood by American physicians that our method of estimating the voltage is vastly different from the method used in Germany. In America, in estimating the voltage passing between two points, the root mean square (r. m. s.) voltage is

used, (5), which means that for a ten-inch spitting spark, roughly speaking, 100,000 volts is required. In Germany, the peak voltage method of measurement is used, so that in order to make our voltage reading correspond to theirs, we should multiply the American voltage by 1.4 which will give us the equivalent German reading. For example, by the American measurement, a ten-inch spitting spark between two points, would be equivalent to about 100,000 volts, multiplying this by 1.4 would give us 140,000 volts which is almost 50 per cent. difference to the German equivalent. This voltage as reported by men who have recently visited German clinics and have seen the treatment actually being administered, is the maximum voltage which is actually used in clinical work; consequently, the German clinical technique employs no higher voltage than that which some of the American radiologists have been using for a number of years.

The whole problem then resolves itself into the matter of shooting a lethal dose into the cancer tissue without destroying the superimposed structures. I feel that it has been definitely proven that this can best be accomplished by the employment of high voltage current combined with radium used in the hollow viscera, or even as needles inserted into the tumor itself. In this manner we should expect the maximum percentage of good results.

Summary

The technique recommended in the above description must be adopted very cautiously by those who have made sufficient study of x-ray therapy to thoroughly understand the principles involved. One of the chief factors involved in this technique, it appears to me, is the fact that we must step up our voltage to produce a shorter wave-length which is of greater penetration in order to correspond to the increased filtration employed. That is, I cannot see any advantage gained by employing the equivalent of twelve or thirteen millimeters of aluminum as filters and using only a nine-inch spark gap which has already been proven, is scarcely sufficient to penetrate six millimeters of aluminum. When using this extreme dosage the patient must be thought of as well as the condition for which he is being treated, so that the patient must be prepared for treatment a day or two by rest in bed, elimination and alkalinization. The patient then must have the greatest aftercare. We feel that it is impractical to deliver a lethal dosage at one sitting if we want to have the patient live after we get through with the treatment, so in our opinion the lethal dose should be administered, spreading it over about three days time. This leads us to the conclusion that it is going to be almost impractical to use this technique in the office. Practically all of this treatment must be administered in the hospital. Its chief usefulness would appear to be for malignancies involving the pelvic viscera and in deeper structures of the trunk of the body.

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Discussion

DR. G. E. RICHARDS, Toronto, Canada: I regret that I have not my lantern slides with me to show while discussing this paper on deep therapy. I shall give you a resume of the work we have been doing and the conclusions we have allowed ourselves to draw.

We have been working a little better than six months with an apparatus which gives us a full measure 12 inch spark gap between blunt points, the ordinary blunt points used in this country. This is the measurement taken when the tube is running. For the first three months of that period our spark gap was measured about 11.5 and the last three months it was a little better than 12. We have averaged it up and called it 12. Our filtration has been one sheet of ordinary photographic glass. We are using 11x14 plates. There was a filter of 10 mm. of aluminum below the glass. The object of the glass was first of all to protect the tube from puncture and secondly, the glass is equivalent to 1 mm. of aluminum for our purpose. We have eliminated all the other filters and are merely working with the equivalent of 12 mm. of aluminum. Our skin distance has been 10 inches throughout. We have passed 5 ma. of current through a standard Coolidge tube against the advice of Dr. Coolidge with no damage to the tube. I changed the tube at the end of three months in case something would happen to the tube, but nothing happened. We run our apparatus in periods of 10 minutes, then rest the tube for 10 minutes and then another 10 minutes of exposure until we deliver our total dosage. Our total dosage will perhaps work out somewhat as follows: In 60 minutes exposure we get a very nice reddening of the skin with no discoloration; in 70 minutes we get discoloration; in 75 minutes in one case in which I have that exposure we got a burn of the first degree with sloughing, which healed in six weeks without further trouble. So much for technique. The results have been encouraging and in two or three instances I felt that we could be enthusiastic, especially in cases of sarcoma in which we have gotten apparently very much better results than anything we ever obtained before. We had 15 cases of sarcoma under treatment, of which I think 8 have disappeaed and have given no evidence whatever of recurrence. Those include osteosarcoma of the ilium, osteosarcoma of the mandible, the small round cell sarcoma arising in the neck. We have two cases of primary sarcoma of the lung. Of these we have one case which has disappeared for more than four months and one still under treatment. We have one case of secondary sarcoma of the lung and one case each, severe cases, of sarcoma of the tibia and of the femur. The last series of cases have been uniformly good. We have a case of carcinoma of the pancreas, which is to me of great interest. This was a case diagnosed by the x-ray. On the basis of the x-ray report operation was undertaken and the diagnosis poven correct. Sections were made and reported by the pathologist as adenocarcinoma. After three series of treatment extending from Septem ber of last year to March of this year, during which time we gave three series of intense treatment, the mass dis appeared and the patient has gained 45 pounds in weight and is now back in business. When the treatment was undertaken he weighed 91 pounds, so he now weighs more than normal. I do not want to use the word "cure" in connection with this case because I realize the fallacy of speaking of cures in so short a time. From radiographic standpoint the stomach area is normal.

We have several cases of carcinoma of the side of the neck with good result. We have six cases of carcinoma of the uterus with apparent improvement and several other cases which make one feel enthusiastic. The chief thing I would like to say would be to describe two cases in which we had fistula. One was a case of carcinoma of the pancreas. In this case the carcinoma was primary in the pancreas and proved at operation. It involved the pyloric end of the stomach. I gave him the same intensive radiation that we gave the previous

case of carcinoma of the pancreas. In no case have we administered intensive radiation all in one day. We gave the following treatment: The first day he received four areas, one anterior, one posterior, and one on each side. A perfectly normal skin reaction followed. An erythematous skin reaction followed the second dose. This all subsided within ten days. At the end of the fourth week he was taken with sudden severe attack of vomiting in which he vomited up a piece of tissue with blood and pus. He died in 24 hours. No post mortem could be obtained and therefore we have no means of knowing what happened. We believe the whole mass sloughed and not sufficient resistance had been given by nature to take care of such an occurrence as ordinarily happens in an inflammatory change.

The second case was carcinoma of the oesophagus of which we have treated two. In each case complete relief in swallowing occurred. These cases wee both completely obstructed. In each case at the end of six weeks the patients could swallow ordinary foods, such as thick soups with pieces of toast, tea and toast, etc., just as easily as I could. In one case the skin reaction subsided after six weeks. At the end of that time without any warning or without previous hemorrhage a piece of carcinomatous tissue sloughed out and the patient died of hemorrhage before any medical relief could be obtained. Surgeons have told me that they have had the same thing happen and they did not feel it was necessarily due to the effect of the treatment. I cannot help feeling it was due to a disintegration of the cancer tissue.

*—Read at the Mid-Summer Meeting of The Radiological Society of North America, held at Boston June 3rd and 4th, 1921.

The Treatment of Naevi

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Detroit, Michigan

"CAN a birthmark be cured?" Such is the query of surprise one often hears from the layman when the latter is informed a birthmark may be removed from a child without leaving a very noticeable, or, sometimes any scar at all. To the general public and to not a few medical practitioners, the birthmark is an enigmatical affliction that must be endured, the removal of which would be fraught with the gravest danger, or at least a disfiguring scar. The average layman regards it as the result of a maternal impression during the prenatal life of the individual concerned. Of course there is no scientific ground for this theory. It is not generally realized that many birthmarks do not begin to develop until varying periods after birth.

These popular and semi-popular impressions concerning naevi (from the latin, nascor, meaning to be born, hence birthmark) should be corrected for it is a crime against both society and the individual marked, to allow a child to grow up with a conspicuous, ugly and deforming birthmark, when the latter may be safely and usually painlessly removed during infancy, by methods which leave but little or no scar at all. As the child grows older the removal of the difficulty becomes less successful from a cosmetic point of view.

Just now our profession is waking up to the idea that it is better ethics to take the public into its confidence, and not hide its light under a bushel, as in the past. As medical men, we are naturally servants of the public, educated largely at the public expense, and it would seem to be our duty to properly, and in an ethical manner, give to the public the facts we have learned, when it is to be benefited thereby. Of course the trouble has always been, and may continue to be, that when the medical individual attempts to give the public this information, the latter is likely to be prejudiced, thinking it is for personal gain, and so leads to quackery. But if a recognized society endorses the information as in the case of the American College of Surgeons in the propaganda concerning cancer this difficulty can be avoided.

It would seem to be the duty of a society such as the Radiological Society of North America, to carry on some propaganda about cancer, and naevi as well.

As Darier remarks, "naevi would be more accurately described deformities of the skin, of embryonic or developmental origin, appearing at any age and taking a very slow course."

This definition would then include several dermatoses not ordinarily classed with naevi, such for instance, as ichthyosis, keratosis palmaris et plantaris, fibroma moluscum, v. Recklinghausen's Disease, adenoma sebaceum, syringocystadenoma and even so common and simple a disease as millia, etc. These we shall not consider in this paper, but confine our remarks to

1. Vascular naevi — including those derived from blood vessels known as angiomata, and those derived from lymphatics, known as lymphangiomata.

2. Non vascular naevi, which includes plane pigmented macules and patches, and raised soft and hard naevi, pigmented or non-pigmented, smooth or hairy.

It is rare to find an individual who has not a naevus on his body somewhere.

Vascular naevi are often present at birth, but by no means always, and they may develop a few days or weeks, or even years, after birth. They usually increase rapidly in size for a while, and then come to a standstill. Occasionally they go on and cause very serious and revolting deformities, particularly of the lips, cheek, eyelids nose, etc. There may then be great danger of serious haemorrhage from trauma. They are plane like the port wine stain, of any color from pink to livid blue, according as the unusually dilated vessels are superficial or deep; or they may be elevated, or tuberous cavernous. They more frequently involve the skin of the face and upper part of the body, but may involve any part, including the mucous membrane.

Occasionally they retrogress without treatment, and this fact seems to be deeply impressed on the minds of some of the profession for I have had many patients come to me with children with birthmarks, and they have stated that their physicians advised them to leave them alone, thinking they would go away of themselves in time. This is very bad advice, for most naevi do not spontaneously retrogress and many of them grow to very large proportions in a comparatively short time, so that they are very disfiguring or even dangerous. Treatment then cannot be expected to yield as favorable results as it might at an early stage. The younger the victim of the deformity, the more susceptible are the cells of the dilated and thickened capillaries to radiation, and the better the repair process.

Every physician and parent should be acquainted with these facts and just as in cancer, the earlier the naevus is treated the better.

If this plan were followed many children would be spared much sorrow, inconvenience and embarassment when they become older.

My first experience in the treatment of port wine stains was in 1903 when I used the Finsen-Reyn Lamp. A brief report of three of these cases in adults was made in an article entitled the "Finsen Light Treatment" printed in the New York Medical Journal and Philadelphia Medical Journal, August 20, 1904. We quote from this article as follows:

"Wine colored birthmarks are speedily and permanently removed by the Finsen Light and the treatment of three of these cases has given the writer much satisfaction, not to mention the gratitude and happiness of his patients. The reaction in some of these cases is slower in appearing than in others, not manifesting itself sometimes until forty-eight hours after treatment. Then the characteristic vesiculation about the border of the treated spot appears, while the centre becomes brown. After a few days the skin peels off and leaves an area exposed, which is several shades lighter than the original birthmark. This can now be treated again in two weeks, and an additional blanching takes

place. If, however, it is not treated again for two or three months, it will be noticed that the spot continues to grow lighter for a considerable period. After a few treatments at intervals of a few weeks or months, the redness entirely disappears."

I have not had occasion to modify this dictum to any great extent since, except that in adults all the color does not usually disappear and the process is slow instead of being speedy.

Two of the cases mentioned had birthmarks involving the whole side of the face from forehead to mouth. They were almost completely cleared up, a pinkish, or, in places, a very white skin being left. One had had her face disfigured worse than ever by scars from electrolysis before she came to us for treatment. In both of these cases the blood could be easily pressed out by the diascope, and the color of the birthmarks was light red.

The third case was of much deeper involvement and the color was a dark bluish red. We only secured some diminution of color here, but the patient was not faithful with her treatment. Treatment was given as usual by the Finsen Light, by making compression with a quartz chamber with water flowing through it for 25 to 30 minutes, to an area about the size of a quarter or perhaps the size of a dime, according to the contour of the surface at the location of the area treated. It was necessary always to press the blood out of the area upon which the light was directed as Finsen had shown that the blood absorbed the ultra violet rays and prevented their further penetration. This method, it can be seen, consumed many hours of tedious work as the quartz chamber had to be held steadily in such a manner that the concentrated light from the lamp fell on the skin exactly perpendicularly, and just within the focal point so as to prevent actual burning.

In 1907 I imported a Kromayer (mercury vapor quartz) lamp and soon found that I could do this work much quicker. I obtained equally good results with pressure in five minutes so I have continued to use this lamp up to the present. It is essentially the same as has been manufactured in this country for the past few years.

In the use of the Kromayer Light the same technique of treating under quartz pressure with Finsen Light holds.

Although we have used radium in a number of cases of port wine stain since 1910, the Kromayer Light is still our instrument of choice and our results are for the most part satisfactory. Dr. William L. Clark in an article in the Therapeutics Gazette of May 15, 1916, endorses this method strongly and urges the use of ultra violet rays, filtered through blue quartz for an average of about 40 minutes to each area treated.

The elevated tuberous or cavernous naevi respond well to radium. Since 1910 we have used radium plaques for this purpose, crossfiring where possible. One of these plaques 2.5 cm. square, made in Paris, is supposed to contain 2 mg. of radium sulphate, one quarter pure, distributed throughout a varnish surface. Another contained 4 mg. one-half pure, distributed over a varnish surface 1.5 cm. in diameter.

A baby, ten months old, had a cavernous naevus of deep bluish red color on the nose, which protruded some distance and appeared to be about the size of a

large cherry. It was soft and compressible, so that my finger on pressure on the end of the nose would sink into a depression about 1 cm. deep. On April 16, 1910, we applied a 2 mg. plaque with a filter of 1 mm. of silver and four or five thin sheets of paper one side of the angioma, for 12 hours, then immediately placed the radium on the other side for another 12 hours. In about two weeks there was a slight reaction and in two or three weeks more the angioma was thought to be smaller. A similar treatment was given 5 weeks later. The angioma continued to grow smaller and in a year's time one could scarcely see where the growth was. The girl is now ten and a half years old and there is no scar, deformity or any indication of any former growth on the nose.

We have treated several small naevi, mostly elevated and some cavernous in very young babies, at varying intervals since 1910 with one of these plaques, using in the more superficial cases, a filter of five or six pieces of thin paper and leaving the radium on seven or eight hours, with very satisfactory results. The naevi and temporary scar gradually fade away in these young cases until in one or two years there is not even a slight scar to indicate the site of the former growth.

When I visited the late Dr. Wickham in Paris, in 1908, he advised me to use a small amount of radium, even as little as .5 mg. in plaque for the treatment of plane vascular naevi. In the cases he reports in his book, he used much larger quantities. But I have found his advice to me good, and when later I tried large quantities of radium in tubes in these naevi, I was disappointed. My practice has been to give only one to three doses at intervals of 6 weeks to 3 or 4 months, not smaller doses every day, or every few days, as is frequently done, until the maximum is reached. I have been disappointed in this treatment, however, in several cases of large plane naevi both in children and in adults, and have found the quartz light much more satisfactory.

We have treated one case of lymphangiamatous naevus in a child one year old. It appeared as several waxy, whitish or yellowish white, deep hard permanent vesicles and scales at birth, on the chest. Its father and grandfather had similar lesions. Three applications of the radium with 1 mm. of silver and several layers of paper for about 17 hours, were used, several weeks apart. The growth disappeared in about 5 months. The child is now about 8 years of age and there is some slight pigmentation and telangiec tasis about the area treated. We got rather severe reaction from the first application of the radium and this caused the telangiectasis and pigmentation.

Spider Naevi and Senile Angiomas

Spider naevi appear on the face or hands about puberty or sometimes later. They are small red spots, about 1 mm. in diameter, with arborescent branches extending out about 1 to 3 mm. I have failed in these cases with both radium and ultra violet light. Electrolytic punture or dessication with Oudin spark has given the best results in these little naevi. The same treatment can be applied to the senile forms, which are little rounded red spots about 1 to 3 mm. in diameter. They appear any place on the body and often retrogress without treatment. It is seldom one is called

upon to treat these. I have seen a large number of these develop suddenly all over the body and in two patients whom I had treated with the old x-ray deep therapy technique for uterine fibroid. Most of the spots retrogressed though some have persisted for six years. They have been erroneously regarded as beieng indicative of carcinoma of the abdominal viscera. Darier and others regard them as delayed naevi

Non-Vascular Naevi

1. Plane pigmented macules and patches—Naevus spilus.

We have had no success with light, radium or x-ray in these cases. Carbonic snow has yielded very fair results and dessication has also been of considerable value. Both these methods are painful and the latter can only be used under local or general anaesthetic. Treatment with them leave soft superficial white scars.

Raised Non-Vascular Naevi

Ordinary small or medium sized moles we have usually treated quite satisfactorily with electrolysis or dessication. If electrolysis is used it is preferable to have ten or twelve needles conveniently attached to the negative pole so as to save time. The needles should be inserted not more than 1 mm. apart, through the base of the growth, and should cover every particle of the area of the base so as to destroy the mole in its entirety to avoid great danger of malignancy.

I have seen several cases of carcinoma develop from moles which had been excised, and some from moles which had undergone some trauma. In treating non-vascular naevi one must be exceedingly cautious to destroy every cell of the growth at one sitting if possible. When electrolysis is used and the needles are all in place the positive pole is applied elsewhere on the body (I usually have the patient place a hand in saline solution connected with the positive pole) and 2 ma. of direct current are turned on for 2 minutes or longer. When this is complete I often change the position of the needles so that they enter the growth in another direction, being careful to destroy the outer border in its entire circumference. Usually the wound will heal in 2 or 3 weeks and there is no more trouble. The scar will gradually fade out during several months and in a year is not very noticeable.

I have also used radium in small quantity satisfactorily on moles.

In the larger, elevated, non-vascular naevi, it may be advisable to use a combination of radium and carbon dioxide snow, or dessication. The radium reduces the size and depth of the growth but will not affect the color if it is pigmented. Snow or dessication must be used for destroying the pigmented area later. If the mole or growth has numerous coarse hairs these can be permanently destroyed by radium, or electrolysis. In these cases of pigmented naevi we do not use the weak plaques but a sufficient number of radium needles to cover the area containing a substantial amount of radium, properly screened, for fairly deep action in the cutis.

Hard verrucose naevi usually appear during the first year. They are usually pigmented, more or less, but only exceptionally hairy. They are best treated with well screened radium, if very thick, followed by dessication.

We have not mentioned caustics, cautery, or excision in the treatment of naevi. We believe they are rarely called for. The

field properly belongs to radiology and electrotherapy. Carbon doxide snow is the exception so far as caustics are concerned. Capillary naevi should not be treated by electrolysis, as irregular scars are left with red between, so that later treatment by other methods is not so satisfactory.

We have not found the x-ray to be a safe or effective method of treatment and advise against its use in naevi.

In Conclusion

1. There is great need of propaganda for the public as well as the general practitioner as to the advisability of properly treating at the earliest possible moment all naevi by radiological, electrical and carbon dioxide methods. The earlier the treatment the better the results. The right of the child to be spared the humiliation and embarrassment of disfiguring birthmarks should be insisted upon by this and similar societies.

2. Kromayer, or Finsen Light, gives best results in port wine marks.

3. Radium in small quantities over long periods of time gives satisfactory results in raised or cavernous haemangiomata.

4. Dessication of carbon dioxide snow can be used to best advantage in plane pigmented naevi.

5. Radium followed by carbon dioxide snow or dessication give good results in raised, verrucous, soft, and hard naevi, with or without hair.

6. Electrolysis or dessication are indicated in soft moles.

7. The tendency for moles and pigmented naevi to become malignant must ever be borne in mind, and thorough radium treatment be used preliminary to other treatment in indicated cases.

Discussion

DR. ALBERT SOILAND, Los Angeles, Cal.: It was a pleasure to listen to these two papers on such an important subject, by men who know their business and know what they are talking about. Those of us who are doing much therapeutic work know that approximately three fourths of our daily work deals with superficial conditions, malignant and otherwise, and I feel that we cannot emphasize this subject too strongly.

I was very much interested in Dr. Grier's presentation of his teatment of superficial lesions, particularly those around the eye, and while he is taking a rather strong attitude about using massive doses around the eye, I think he is on the right track and if we will follow him, I am sure we will see his good results.

I do not quite agree with his dogmatic stand that a specific number of treatments will always suffice. So many of these cases are not of the type which will respond to one, two, or three applications. Some of them will not get well no matter how much you give them. His pictures, however, show that he gets results, and I want to voice my respect for his method.

The question of moles is an important one. Aside from the pigmented appeaance of many of these, there is always a danger of potential malignancy. Like Dr. Stevens, I went through the Finsen light treat ment, and spent part of two or three seasons in the Finsen Institute. I was interested in his work on lupus. In this country, however, the people have not the patience to spend the necessary time with the Finsen method. We find that radium and x-ray will handle lupus just as well and in a much shorter period of time.

The main desideratum with naevi is the successful removal of pigments. Of all the agents which Dr. Stevens has enumerated, I believe that carbon dioxide snow used to its full effect is the best single agent we have to destroy pigmented naevi, provided they are not too large. The dessication method of Oudin is a wonderful help in treating the raised and non-inflammatory type of moles or naevi. In the inflammatory kind, those that are either malignant or potentially so, I believe should be treated with radiation.

It would take a long time to go over all the points Dr. Stevens covered. I believe we should all pay more attention to the complete destruction of our superficial lesions than we have heretofore.

DR. ROLLIN STEVENS, Detroit, Mich., (closing his part of the discussion): In reply to Dr. Grier's question as to what I mean by dessication, I follow Dr. Clark's method and simply use a very small hot spark around the mole, then all over the surface, and then run the needle into the substance of the mole in two or three places. Then the surface is cleaned off and the spark applied again and so on until the whole thing is taken away in one sitting. We use the monopolar method, but if you use the bipolar method you have to use a general anesthetic. You cannot use the bipolar method without it.

*—Read at the Mid-Summer Meeting of The Radiological Society of North America, held at Boston June 3rd and 4th, 1921.

Radiotherapy in Superficial Malignancy

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THE value of radio-therapy in superficial malignancy is now so generally recognized and the method of treatment so standardized, that any extended remarks on this subject seem rather superflous. My reason for taking up the time of this body of expert radiologists with such a time-worn subject is to emphasize or rather re-emphasize, for all I have to say has been published by many authors, the importance of certain fundamental facts in the treatment of superficial malignancy. The secret of success in this work lies in the following points:

1. Use a destructive dose to the point of tissue necrosis throughout the lesion.
2. Apply all this dose in such a short period of time that there will be no chance for tissue reaction between treatments.
3. Do not use any filter because the large dose necessary to produce this necrosis, with filtered rays, will produce an obliterating endarteritis deep down in the tissues and a consequent roentgen ulcer which will not heal.

This is a summarization of the massive dose method of treatment of superficial lesions and is the logical sequence of the Coolidge tube.

The first case treated in our laboratory according to these ideas was treated by the author on April 4, 1915. The patient was a charity case referred from the wards of a Pittsburgh hospital. This woman had a large epithelioma of the nose. We gave her 5 ma. for 10 minutes at 8-inch skin focus distance, using a 6½-inch parallel spark gap, and no filter of any kind. This dose was repeated on the second day following and we then "stood pat." In about a week she returned with the most violent x-ray reaction possible, and a friend with her who spoke sufficient English to inform us that we had "ruined" her. We had our misgivings also, but discreetly held our peace. In due course of time the reaction subsided, and the wound healed with a negligible scar and has re-

mained well since. We have used this same technique ever since with such variations as I shall specify.

In order to prevent recurrence it is necessary to expose a small margin of healthy skin or mucous membrane entirely around the lesion, say ⅛-inch or slightly more. If this is not done, recurrence will take place in the edge of the scar. No uneasiness need be felt about exposing this edge of healthy skin as it will heal up with the rest of the lesion. Tissue necrosis will, of course, result from the treatment and the resulting ulcer will heal up by granulation. Healing will be facilitated by keeping the lesion clean by means of sterile dressings, frequent cleansing with antiseptic solutions, or the application of antiseptic to the wound is sure to end disastrously. Under no circumstances must it ever be dressed with wet antiseptic dressings, or any kind of ointment. This is a good rule to follow where any skin surface has received anywhere near a maximum dose of x-rays. It is necessary to warn the patient not to put anything on the sore and not to pick the scab off. Otherwise, the wide variety of home remedies which will be used, from olive oil to turpentine, is really startling. We have been mystified many times to understand why the wound would not

Figure 1 shows character and extent of lesion usually cured by one treatment.

exposed to the open air as much as possible. If an attempt is made to keep it covered by any sort of a dressing, the traumatism incident to changing the dressing will pull off part of the scab each time the dressing is changed and delay the healing. After tissue destruction has taken place, the main object is to get scab formation as soon as possible and to keep each scab on until it comes off itself. The wound, of course, will be infected and pus will discharge freely. Any attempt to keep this wound bacteriologically heal, only to find later that the patient had been carefully removing the scab daily and applying peroxide of hydrogen, boneset tea, or some other pet cure-all. If the proper dose of rays has been administered, the only further thing to be done is to leave it absolutely alone.

The selection of a proper dose for each lesion will, of course, require a certain amount of judgment and experience. Our standard treatment as enumerated above consists of 50 ma. minutes at 8-inch skin focus distance, 6½-

inch parallel gap and no filter. We give from one to four of these treatments, allowing an interval of one day between treatments or the treatments may be given daily. There seems to be no logical reason why the treatment should not all be given at one sitting, varying the time factor only. We have made several tentative trials at this change in technique, but not very successfully, and each time have reverted to the method of treating every other day up to four treatments. Our difficulty in giving the dose all at one sitting has been to judge correctly the length of the treatment necessary to replace two, three, or four treatments on alternate days. One treatment of 17 minutes seems to give the same result as two 10-minute treatments given on alternate days, but beyond this we have made no progress. The interval between treatments should not be more than two days, or the effect will be different. If the treatments are spaced a week or two apart, this technique will not be satisfactory; and if the lesion does heal by this method, the percentage of recurrence will be much larger. We have had this experience many times. The successful x-ray treatment of malignancy seems to depend on giving a knockout blow at one time, and apparently this method of treating every other day has the same effect as if it were all given at one sitting. However, if a sufficient time is allowed to elapse between treatments for the tissues to recover from the effects of the previous treatment, the result will be entirely different. In order to treat successfully by this method it is necessary to examine the case carefully, decide how many treatments you are going to give, apply the treatments on alternate days and wait for the result. It is absolutely disastrous to give one treatment, wait the two or three weeks necessary for this treatment to take effect, and then if it is not enough give another treatment, wait again and so on. Whatever treatments are necessary must all be given close enough together that the effect is practically that of one treatment.

Figure 2 shows character and extent of lesion usually cured by two treatments.

The question of the number of treatments necessary is, of course, one of judgment, and occasional mistakes are inevitable. The smallest and most superficial of epitheliomata will yield to one

ten-minute treatment. If the skin is ulcerated at all it is wise to give a second treatment of either five or ten minutes. An epitheliomata about the size of a dime with a crater one-eighth inch deep or more, with thick indurated edges will require three treatments; and a large deep rodent ulcer, or a fungating cauliflower like growth on the face or lip will require four. As a rule, lesions on the lip and hand require a little more treatment than those on the face. With these two exceptions, it is our rule not to give more than four of these treatments at one time. Occasionally, cept on the lip or hand where two or three more may be given.

As before stated, no filter of any kind should be used. If the amount of treatment given is small and a filter is used, the lesion may heal but the percentage of recurrences will be fairly large. If a large amount of treatment is given so as to produce an x-ray burn, and in this technique without a filter a burn of some degree always occurs, if a filter has been used it will be very difficult to get this burn to heal. The x-ray burn produced in treating skin malignancy without a filter up to the four doses described will al-

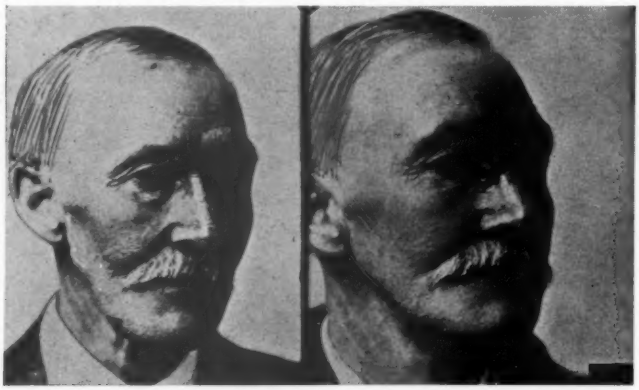

Figure 3 shows character and extent of lesion usually cured by three treatments.

a very large, old, or indurated growth will not entirely respond to this treatment, and at the end of four or six weeks, there will be a little edge, or some other more resistant part of the growth which has not disappeared. It will then be necessary to give another destructive dose to this part in the same manner as at first, using the number of treatments that the remaining lesion seems to require. The line has to be drawn somewhere as to how many of these massive treatments may be given, and in our experience four is about the limit ex-

ways heal in from six to eight weeks. In treating malignant ulcers with very deep hard edges, the logical thing seems to be to use a filter so as to get penetratinfi rays to affect this hard deep lesion. This is entirely wrong although it seems to be the natural trend of the radiologist's mind, and it took us three or four years to get it out of ours. A large percentage of our recurrences are due to this fallacious reasoning. Never use a filter when treating on epithelioma because it has thick hard edges. These edges are malignant and the purpose is to de-

stroy them and this can be better accomplished by the large quantity of soft rays that have an escharotic effect than by the more penetrating filtered rays that go on through. Treatment can be facilitated in this kind of cases by using fulguration with the high frequency spark over the indurated edge before the rays are applied. Fulguration is a great aid to radiation in any instance where a large amount of superflous epithelium has to be destroyed. With the proper kind of a high frequency coil and by using an ordinary cambric needle as the sparking point, this fulguration can be done without any anaesthetic whatever. It is painful, of course, but it can be borne. We have treated several cases of superficial epitheliomata by fulguration alone, but a good percentage of these have recurred and we believe it is always wise to supplement this by x-ray treatment.

Since April 1915, we have treated 315 cases of superficial malignancy by the massive dose method in our laboratory. Of this number thirty-six have been treated by my associate, Dr. Geo. C. Johnston, 257 by myself, and twenty-two cases have been treated by the two of us jointly. Practically the same technique has been used in all. In these cases the lesions were mostly about the head and face. A few were on the hand, back, chest, or some other part of the body.

When treating areas that are habitually covered by clothing, a little smaller dose should be given than to exposed areas. Lesions on the hand and lip will require more than other places.

TABULATION ACCORDING TO LOCATION

		Cured	Recurred	Failed
Epithelioma Nose	73	73	..	..
" Face	53	53	..	..
" Eyelid	48	41	6	1
" Forehead	24	24	..	..
Carcinoma Lower Lip	23	19	2	2
Epithelioma Ear	22	22	..	..
" Temple	18	18	..	..
" Neck	8	7	..	1
Rodent Ulcer Temple	7	5	..	2
Epithelioma Upper Lip	7	7	..	..
Leukoplakia Lip	7	7	..	..
Carcinoma Hand	6	6	..	..
Rodent Ulcer Ear	5	2	..	3
Carcinoma Eyeball	4	4	..	..
" Scalp	4	4	..	..
Rodent Ulcer Forehead	3	2	..	1
Carcinoma Cheek	1	1	..	..
" Back	1	1	..	..
Ca. Nodule in Scar	1	..	..	1
	315	296	8	11

Treatment of carcinoma of the lower lip should, of course, always be supplemented by radiation of the glands beneath the jaw and in the neck whether they are palpable or not. Out of twenty-three cases of carcinoma of the lower lip, we have had nineteen cured, two failures and two recurrences which were referred to the surgeon. We believe these results are much better than can be obtained by surgery. In addition, the deformity from this treatment is negligible, but very disfigur-

ing where successful surgery has been done.

In treating about the forehead or scalp, if the disease involves the periosteum, the treatment will not be successful. Likewise on the ear if the cartilage is involved. In lesions about the eyelid, it is wise not to use any larger doses than are actually necessary since the amount of ectropion resulting will be directly proportional to the amount of tissue destruction. However, unfiltered rays should be used. All of our recurrences in epithelioma of the eyelid have due to the use of rather small doses of filtered rays, and one of these cases has recurred four times and is still unhealed at this writing over four years after the case was first seen. In carcinoma of the eyeball, we have used one-fourth of the standard treatment, without filter, repeated every other day for four treatments and then wait for results. We have already reported three cases successfully treated by this method and since then have had two more, one of which is not included in this report, but which has been entirely well for two months at the time this is written. One case of melanotic sarcoma of the eyeball is now under treatment. It is improving, but has not responded in the very satisfactory way that our carcinoma of the eyeball cases have.

Out of 315 cases treated, 278 were cured after the initial course. Eighteen recurred and were cured by subsequent treatment, making a total of 296 cures out of 315 cases, or about 9 per cent. Eight cases recurred after additional treatment, and in eleven cases treatment was not satisfactory and had to be abandoned, making nineteen unsuccessful cases out of 315, or about 6 per cent.

Figure 4 shows character and extent of lession usually cured by four or more treatments.

			Percentage of Cures
Healed after initial treatment	304	..	96%-|-
Recurred after initial treatment	26	..	8%-|-
		278	
Cured by radiation after recurrence...	..	18	..
TOTAL CURED.	..	296	94%—
Failed to heal after initial treatment...	11	..	..
Failed to heal after recurrence	8	19	6%-|-
TOTAL.....		315	

Quite a large percentage of the recurrences were apparently due to the fact that they had been treated by filtered rays.

Recurrences

Where filter was used.....	14	..
Where no filter was used...	12	26

Analysis of 12 cases where no filter was used:

Only 1 treatment given.....	2	..
Two treatments given, 1 month apart.....	1	..
Treated by fractional doses over long period previous to our treatment	2	..
Successive recurrence in one case previously treated with filter	3	..
Rodent ulcer involving cartilage of ear.....	1	..
Treated by regular technique, no filter.....	3	12

Of the cases of recurrence that were treated without a filter in nine out of twelve cases, a logical cause for the recurrence was noted. Of the three remaining cases, I have found since this table was compiled that in one of them the recurrence was in the edge of the scar and palpably due to the fact that too small a margin of healthy tissue had been included in the original treatment. This leaves only two cases out of twenty-six recurrences where the regular technique was used and where there was not a logical reason for the recurrence.

Use of Filters

No filter used in....	241	..	76%
Filter used in part of or all treatments..	74	..	
		315	
Recurrences—			
No filter used in....	12	..	46%
Filter used in part of or all treatments..	14	..	54%
		26	
Failures—			
No filter used in.....	5	..	46%—
Filter uhed in part of or all treatments.	6	..	54%-|-
		11	
Cures—			
No filter used in...	228	..	77%—
Filter used in part of or all treatments.	68	..	23%-|-
		296	

Of the eleven failures, one case of carcinoma of temple may have been luetic, although Wasserman was negative. She was turned over for anti-luetic treatment, but never came back. One case of carcinoma of the temple we cured by radium after x-ray had failed. This may have been due to faulty technique in the x-ray treatment. One case of carcinoma of the lip had been treated by an amateur radio-therapeutist for five months, apparently with fractional doses. This case healed up under a massive dose, but recurred five months later and the recurrence would not heal by x-rays, or radium needles, and we turned him over to the surgeon, but he never appeared for operation.

In three cases of rodent ulcer of the ear, failure was apparently due to the fact that the cartilages were involved. These cases were all cured by operation.

One case carcinoma of forehead eroded into the frontal sinuses and treatment was not effective, although the lesion became very much smaller; in fact, healed up to the place where the bone was involved. This patient was an old lady seventy-five years old, she came about 200 miles for treatment, the surgeon refused operation, so we advised her to abandon treatment. She is still living and the lesion is slowly advancing.

One case of rodent ulcer beneath lower jaw recurred after being treated with filtered rays and would not respond to further treatment. He was cured by operation.

One case of subcutaneous recurrence in the scar following healing of a rodent ulcer was treated by large doses of filtered rays. It broke down and would not heal. We supposed it was a

recurrence of his rodent ulcer and had him operated. The pathologist failed to find any evidence of malignancy in the tissue removed, and our opinion now is that the ulceration was a chronic roentgen ulcer following massive treatment with filtered rays.

Our experience with malignancy inside the mouth has not been so happy as that of cutaneous lesions or lesions on the lip. Previous to our acquisition of radium, we always refused to treat these lesions as we felt better results would be obtained by operation with cautery than by any x-ray treatment that could be applied. In the last three years, we have treated twenty cases of malignancy in the mouth with radium:

Radium Cases

	No. Cases	Cured	Improved	Died
Ca. Alveolar Process	7	1	2	4
Ca. Cheek	4	1	†1	2
Ca. Tongue	3	‡1	..	2
Recurrent Ca. Lip after Op.	1	..	..	1
Ca. Middle Ear.	2	..	*1	1
Ca. Lip & Cheek	1	..	..	1
Ca. Tonsil	1	..	..	1
Leukoplakia Chk	1	1	..	..
TOTAL	20	4	4	12

†Operated later.
‡Operated first.
*Still under treatment.

FAILURES

		Apparent Cause Failure	Final Result
Carcinoma Temple	1	Involvement too extensive	Patient abandoned treatments
Carcinoma Temple	1	Treated with filter at long intervals	Cured with Radium
Carcinoma Lip	1	Treated for 5 mo. previously by small doses	Referred to surgeon
Carcinoma Lip	1	Involvement too extensive	Abandoned treatment
Rodent Ulcer Ear	3	Cartilages involved	Operated and all well
Carcinoma Forehead	1	Involvement into frontal sinuses	Abandoned treatment on our advice
Rodent Ulcer Under Jaw	1	Treated first with filter and recurred	Operated, now well
Epithelioma Entire Lower Lid	1	Very extensive involvement. First treated with filter, recurred 3 times	Still under treatment
Ca. Nodule in Scar of Rodent Ulcer	1	Numerous treatments with filter caused deep Roentgen ulcer	Operated, now well
	11		

Of this number we have only four cases living and well today. We have two more almost well at this writing in which we have hopes of obtaining a cure. One of our cases now well (carcinoma tongue), we had operated before we used radium, so we do not

know where the credit belongs in this case, whether to the operation, or to the radium. We believe that some of our failures in these cases have been due to insufficient dosage. We first began giving these cases from 200 to 300 milligram hours, and are now giving 750 milligram hours at the initial treatment. We believe the latter dose is also probably too small. It is even more important in these cases than in cutaneous lesions to give an overwhelming dose at the first sitting. One of our greatest difficulties has been to find methods of keeping the radium in contact with the lesion for a long enough period of time. In our first cases treated we attempted to have the patient hold the radium in contact, but we soon found this was impossible. We now have the dentist see these cases with us in consultation and if he is able, he devises some method of attaching the radium to the teeth, or to a plate if the patient has one, or to modeling compound made to fit. In carcinoma of the tongue, in two or three cases we have resorted to suturing the radium in position. One of these cases healed up and remained well for about five months, but the lesion recurred and the man subsequently died. In lesions about the tonsil, we have been able to keep the radium in position by means of a tonsil clamp in several cases. On the whole, our experience with radium in cancer of the mouth has not been particularly satisfactory. We believe this is largely due to the difficulty in keeping the radium in contact with the lesion for a long enough period of time. This problem is made easier in some instances by the use of radium needles, but there are, of course, many places about the alveolar process where the introduction of needles is not possible. Probably if a dosage approximating that used in cancer of the uterus were used in the mouth, something like the same result might also be obtained.

Discussion

DR. A. F. TYLER, Omaha: I want to speak about two points mentioned by Dr. Grier because I think they are important. The first is, where we have the superficial lesion with a ragged, hard edge to use fulguration with the x ray to destroy that hard margin; also in the cases where I depended on fulguration alone to destroy the ragged edge, I found, as Dr. Grier said, that I was disappointed because I had a large percentage of recurrences. So wherever I use fulguration to destroy the hard margin of the superficial lesion I go ahead and treat it with radium and x ray just as though I had not used fulguration in connection with it.

The Doctor said that when the cartilage of the ear was involved he has been terribly disappointed and has recommended that case to the surgeon. I think that is true, though I have had several cases where the cartilage was involved with ultimate recovery if you give them time enough to repair.

DR. G. W. GRIER, Pittsburgh (closing his part of the discussion): There are one or two remarks I would like to make on Dr. Stevens' paper before closing the discussion on my paper. I have had the same experience as Dr. Stevens as to the use of radium in vascular naevi, that is, the cavernous naevi respond very nicely to radium treatment but the results from the use of radium in the port wine stains have not been very satisfactory.

In regard to the treatment of moles, I do not quite understand what Doctor means by dessication. Is it the same as you mean by fulguration?

There are two methods of treating moles, one consisting in introducing the needle into the tissue and passing the high frequency spark through it and the other is to let the spark jump from the end of your needle through the lesion. I use this second method a great deal in the treatment of moles. In the treatment of moles it is a very satisfactory procedure to

spark these lesions with the high frequency spark until they are turned white and then turn around and give a big dose of radiation. I use the x-ray because I feel I am a little more master of it. I do feel that it is very dangerous to use anything like that on a mole, that is fulguration, carbon dioxide snow, unless you follow by radiation, because you are apt to stir the thing up and change it into a very malignant sarcoma. I have seen several of those cases in young people and they are very beautiful cases.

I think perhaps Dr. Soiland misunderstood my purpose in having a dogmatic method of treating these cases. You have to know how much treatment you are going to give a case before you can see what results you are going to get. In order to demonstrate the method, I said one, two, or three treatments. As a matter of fact often the treatment will be subdivided, that is, we will use one treatment ten minutes, the second five or ten, and third, five. You have to have pretty well in mind how many treatments you are going to give before you start and you have to be dogmatic so as to have some basis to work from.

*—Read at the Mid-Summer Meeting of The Radiological Society of North America, held at Boston June 3rd and 4th, 1921.

EDITORIAL

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The Annual Meeting

THERE is every indication that the forthcoming annual meeting, program of which is printed elsewhere in this issue, will be the most notable event in the history of the North American Society. The program, covering four days, gives assurance of a wide range of practical information of a scientific nature. Indeed, that program is so extensive as to be of very great value and assistance to every medical man be he especially interested in radiology or not.

It is hoped, therefore, that every member of the Society and all other radiologists will make a special effort to attend. The sincere wish is expressed that medical men generally will also attend and take part in the discussions so that all may profit from the interchange of ideas and by a fresh viewpoint on the problems which confront the radiologist and the medical man more strictly speaking.

No effort is being, or will be spared, to make the annual meeting one of the most constructive and instructive events of medical history. Large attendance will be but fitting recognition of the time and labor given by those appearing on the program and the officers who have attended to the tedious details incident to such a large and comprehensive scientific meeting.

A Research Bureau

QUESTIONS growing out of exploratory work in deep therapy, new apparatus and appliances designed to deliver unusually high potentials, physiological factors, biophysics, and numerous other matters of major importance, emphasize every day the need for a properly constituted research program of some sort.

These are problems the responsibility of which should not be abandoned entirely by the profession and left to manufacturers however willing they may be to investigate them.

There are so many sidelights on the practical, or perhaps more correctly speaking, the medical side that no manufacturer, unless he maintain a ruinously large organization consisting of competent medical radiologists and physicists, can hope to provide the data which is so vital to the development of the medical application of radiology.

No argument is interposed against the proposition that manufacturers should maintain research departments. But there is a very distinct line of cleavage between the field of exploration to be covered by such departments and the field the radiological profession so sorely needs.

As it is, these questions are being studied in a haphazard way by individual radiologists at their own cost in time and money. There are a num-

ber of men in the profession who realize the importance of delving deeper into the medico-scientific application of x-rays, radium and electro-therapeutics and they are giving the results of their labors freely and gladly to all radiologists. Witness the broad character of the program of the annual meeting.

However, an organized effort in this direction through The Radiological Society of North America in conjunction with all other agencies, professional, scientific, medical and manufacturing will serve to coördinate all such activities and give the direction and impetus necessary to rapid, extensive and constructive advance of the radiological profession.

A Licensing Board

THE question of licensing x-ray technicians is one the radiological profesison must answer in the no distant future. The best interests of radiology demand it. The conscientious technicians themselves are beginning to demand it. And the medical profession at large will soon come to insist on it.

It is purely a matter of fiction, of course, that lay technicians operating commercial laboratories can render that high quality of diagnostic service which the professional radiologist, can render. The one at best is a photographer, however expert he may be in that line. The other is a man who has paid the price of time and effort for medical schooling so that he may bring to his work specific knowledge of anatomy and disease.

These comments are not founded on a criticism of the lay technician. Quite the contrary. He is a very valuable and efficient factor in the practice of medical radiology. And if he is at all sincere he much prefers to operate under the direction of a competent medical radiologist than otherwise.

Because the technician is so closely identified with the radiological profession, it is probable the latter, in sheer self-defense if for no other cause, will have to provide a means of examining and licensing the former during the period of service under a competent medical radiologist.

Such a method, if handled vigorously and intelligently, ought to serve as a means of dividing the sheep from the goats, so to speak, and eventually go a long ways toward eliminating those who have so little regard for the interests of the public as to attempt diagnosis and treatment without any knowledge of what they are about.

State Medicine

IT is impossible to read "Trailing the Robin Hoods of Medicine", appearing in the October issue of "Century Magazine' over the signature of Mr. Glenn Frank, editor, without experiencing mixed emotions and confused cerebrations.

Briefly Mr. Frank begins his discussion with a statement to the effect that Johns Hopkins Hospital, wittingly or unwittingly has proved its capacity for making front page news by its recent action on the question of fees—a circumstance of which he disposes as "a case of much ado about nothing, an incident that is important only as it may attract public attention to a much broader issue, the problem of an adequate and statesmanlike organization of the medical service of the nation."

That surely is a correct statement of the case. The mere incident of fee fixing by any single hospital however large or small is purely a matter of local interest. But when, as in the case under consideration, the incident assumes such importance as to involve the principle or well established custom by which the whole medical profession gains its livelihood, then every person, layman and scientist,

professional man and business man is vitally concerned. That is true of the precedent set by Johns Hopkins because of the eminent place it occupies in the medical affairs of the nation. And Mr. Frank has very well stated the crux of the matter in a manner that is extremely pungent, one might say almost epigrammatic.

Because the national health question is so urgent no thinking man, the medical man least of all, will be heard to voice objection agaist the conclusion which Mr. Frank uses as the premise of his argument. Indeed, the whole question is so important that it intimidates many otherwise courageous men. Its consequences are so vast, its possibilities so tremendous that the average person evades the subject as fit only for a super mind.

That is why The Journal views Mr. Frank's effort to set down some of the more important phases of this question with more than passing interest. Were it not ludicrous to do so, The Journal would be heard to offer an earnest prayer that some super-intellect, perchance Mr. Frank's, be released of all human frailties for a spell that it might travel unhampered in the far reaches of space, time, and the complications of human affairs indigenous to every community, hamlet, town, county, state or other subdivision of the nation. And to that prayer should be added the wish that there be confided to Mr. Frank the majestic intellect of a superman, the wisdom of the Incarnate, because under that sort of an arrangement the medical profession would not be obliged to formulate any vision of its obligation to society: the rock of ages could be blasted for it by Mr. Frank.

There is no ridicule in this picture. The thing sought to be demonstrated is the utter futility of hoping for a collective intelligence that is larger than individual intelligence. That is the fundamental weakness in Mr. Frank's argument. Let his own words bear him witness:

> "When we get around to the organization of a real health service for the nation, if we ever do, we shall be forced, I think, to an agreement upon the following things as essential:
>
> "First, the virtual elimination of the private practice of medicine, with the substitution of a national health organization in which all doctors shall be servants of the state, with all or a basic part of their income guaranteed. We shall be forced to this if we apply intelligence to the health problem not as a socialistic theory, but as a social necessity. Here are some of the considerations that will force us to this conclusion.
>
> 'Today doctors locate for practice exactly as tailors locate for tailoring, in search of a privately profitable future."

It is somewhat difficult, if not impossible to harmonize such a conclusion with the previous statement that "The average surgeon is much more priest than profiteer," that "money is probably the incentive to expertness more rarely than we think," and that "money may be the incentive to vast effort in many enterprises, but it is rarely the dominant incentive in the arts or sciences."

One of two conclusions is inescapable: either Mr. Frank intended to confine his adulatory remarks to surgeons, or that his indictment of the present medical system is pure sophistry and not founded on fact. To say the least, it is mighty poor logic which permits the assertion in the one instance that the profit motive does not influence the medical profession in any appreciable degree, and in the other, that "Today doctors locate for practice exactly as tailors locate for tailoring, in search of a privately profitable future." That constitutes a dilemma both horns of which no man can hold honestly very long.

Discussion of such an important question should not be conducted on a hair-splitting basis. But it would seem no more than sensible since the

question of profit, or more correctly the profit motive, is bound to assume such large proportions in any fair and intelligent consideration of a national health program, to define the word profit. Money is not the only form of profit. The dictionary gives a much broader definition. Among other things it includes, gain, advantage, accession, of good, benefit, service avail, utility, welfare, weal, improvement, proficiency" as well as "The amount of money obtained by the sale of commodities above the cost of purchase or production; pecuniary gain; emolument."

There is a scriptural passage reading "man cannot live by bread alone," which applied literally or strictly, may be offered as recognition of the fact that the profit motive is of paramount importance to the individual man. And while this is neither defense of tradition nor a plea for the money grabber in the medical profession or out, it is seriously contended that it is sheer nonsense to deny the profit motive in trying to formulate the future conduct of our medical affairs. On the contrary, the profit motive must be admitted as an essential and forceful factor in human affairs. The question at issue is one rather of directing that motive into channels which insure a large social service.

It would be the utmost folly to concoct a national health program which did not take account of economic and social conditions. It would also be nonsensical to adopt a national health program which did not provide sufficient elasticity to permit the characterization and direction of human ambitions. Consequently, any organization of medical science for the national welfare must contain both the opportunity and means for developing in the individual what may very properly be called a social mind.

That is the thing Mr. Frank is struggling for, when he says:

> "A quit-claim deed to immortality is awaiting the physician, surgeon, or statesman who can think of health in terms of a nation instead of a patient, and who can effect the beginnings of a national health program that will insure to every man, woman and child in the United States the full and continuous benefits of the best in medical science and service."

Viewed in the abstract, the social mind may seem about as Utopian as was ever offered by a radical socialist. But there is a very wide difference between the collective mind on which our socialistic and communistic friends lean so heavily, and the individual social mind which offers some hope of relief from the present chaos, indirection, drift. What is that difference? Just this: The collective mind sought to be invoked by those obsessed with the state-making dream is blindly worshipped inversely as the cause instead of the effect: it is looked upon as a force outside ourselves which somehow may be called into use to do our work for us. Tersely, the state-making dream is a binding passion for men who have sensed a break-down of authority in our social and economic life; but it is bound to fail, in fact has already failed ingloriously in Russia, because it is not bound up with a common discipline for motives which do not recognize geographical boundaries.

Contrast that sort of a situation with a deliberate attempt to develop the individual mind according to a high conception and large vision of the social welfare, a constant and consistent effort to utilize the manpower of the nation in achieving the health and happiness of all the people. There is something tangible about that. It reduces the problem to one of individual relations, and immediately one can think of a thousand practical suggestions touching the milk supply in this locality, the water supply in that, segregation and hospitalization of persons suffering from communicable

disease, motherhood and employment, the care of children born out of wedlock, health certificates as a condition precedent to marriage, the daily challenge that is flaunted in the face of our educators by clamorous men and women whose self-sufficiency is destroyed because the things they learned in school do not interpret life as they find it. And these represent but an infinitesimal fraction of the practical problems which enter into a comprehensive and statesmanlike health program.

Probably these are some of the thoughts which surged in Mr. Frank's mind, disturbed his mental poise, and provided the motive vivendi which impelled him to remove the medical profession from its priesthood. Let him speak for himself:

> "Let us play with this idea for a moment, tracing out some of its implications. It is a ticklish subject to discuss if the writer wishes to preserve a reputation for careful sanity. Merely to set down in their relation and in proper perspective suggestions that have been made by the more creative minds in the profession is enough to brand a writer as the irresponsible architect of a private Utopia, if not a dangerous citizen of communistic leanings.
>
> "First of all, I think, we need a fresh, comprehensive, and fearlessly truthful critique of the medical profession, its ethics, its equipment, its fee system, its limitations, and its possibilities. Here and there courageous critics are arising in the ranks of the profession, but it is too much to expect that any practicing physician or surgeon will cast 'discretion' to the winds and give us the fundamental critique that we must have before the mind either of the nation or the profession will be opened to a sympathetic consideration of a truly national organization of medical service that will mean a decided break with most of the traditions."

Here again are irreconcilable statements and diametrically opposed conclusions. On the one hand the more creative minds of the medical profession are making suggestions which a writer desiring to maintain a reputation for careful sanity would not even set down; on the other "It is too much to expect that any practicing physician or surgeon will cast 'discretion' to the winds and give us the fundamental critique that we must have before the mind either of the nation or the profession will be opened to a sympathetic consideration of a truly national organization of medical service that will mean a decided break with most of the traditions."

Just what does Mr. Frank mean? Can we find in his own words the "decided break with most of the traditions" to which he refers? It would seem so. Let him repeat:

> "When we get around to the organization of a real health service for the nation, if we ever do, we shall be forced, I think, to an agreement upon the following things as essential.
>
> "First, the virtual elimination of the private practice of medicine, with the substitution of a national health organization in which all doctors shall be servants of the state, with all or a basic part of their income guaranteed * * *"

Speaking with the utmost friendliness and candor, the suggestion is crudely put. Mr. Frank has not justified it either in fact or theory.

Perhaps The Journal's opinion can be demonstrated by a conscientious effort to understand the fundamentals involved in this proposition. This Journal has no desire to stumble into the same pitfall by criticising another man's opinion and failing to support that criticism by sound logic.

First off, it is absolutely indisputable that anything like a deliberate organization of the medical profession for rational health service on a national plan, will have to be predicated on the socio-economic habits and requirements of the whole people. It will have to take cognizance of the structural contretemps of those two cohesive and articulate units of society ordinarily designated as labor

and capital. It will have to be equally cognizant of, and just with reference to, the welfare of that great surging majority usually differentiated by careless thinkers as the common people. It will have to be and do all this: and yet somehow it will have to avoid the overwhelming and iniquitous condemnations of the intellectual on the one hand, and the perilous discomfiture and ill-mannered resentment of the thoughtless on the other.

That sounds like one of those spectacular oracles about which men theorize but which they never hope to see reduced to practice. It may be that was the spirit which led our contemporary into the animadversion that the science of medicine is incapable of reduction to specific plan for national well-being except through that peculiar over-all influence sought to be vested in governmental agencies by socialistic and communistic dogma.

Such a disposition of the national health problem is unworthy. It begs the question completely and is bound to fail because it does not recognize the fact that there is no mind for the solution of human problems except the human mind. In short, it is sheer reversion to absolutism without even the precaution of providing the absolute.

There is a social instinct running through and vitalizing the medical profession which makes it necessary to look beyond purely scientific motives in any thorough discussion of a national health program.

The great bugaboo which frightens a good many strictly ethical practitioners is the fear that scientific standards are being lowered to a purely commercial basis. That, of course, must not happen. But once and for all the fact may as well be admitted that while the medical man, speaking by and large, is striving to live and conduct his practice on that strictly scientific plane which conforms to the oldest and most sacred traditions of his profession, under present social requirements he finds it absolutely necessary to apply certain business principles and methods to his contact with the human family in order to prevent his falling into utter disrepute and becoming a social charge instead of a promoter of social welfare. Somewhere, therefore, between the two extremes of purely scientific abandon, on the one side, and the cold commercial instinct, on the other side, lays the course of the medical man. For of all men who are human, he must be human: he must take the good things from all in order to give good advice and helpful ministrations to all.

So far as the medical profession is immediately concerned, its real problem now is to enter the whirlpool of events from a fixed starting point impinged on the national health, and endeavor to emerge as soon as possible with a clear conception of the job which confronts the science of medicine from both a preventive and curative aspect.

Specific analysis for the purpose of arriving at the causes which produce the effects men see, should enable the medical profession to do that. True, it may prove an invidious task. It may not even eventuate in a perfect understanding of the methods by which an adequate and statesmanlike organization of the medical service of the nation is to be achieved. But it should lay the foundation on which the superstructure of a national health program may later be reared; and it should prove conclusively not only that the medical profession realizes its responsibilities, but that it is trying earnestly, intelligently and honestly to discharge them in such a way as to safeguard the public health.

Such an effort will mean a lot of grubbing. It will mean the segregation and classification of the whole faltering and bewildering mess of business, professional, scientific and

social life. It is bound to prove an enormous job. But in no other way can a deliberate health program on a national scale be devised.

This sort of an undertaking is no sinecure. Other men will shun it and beg to be let alone in the pursuit of their selfish interests. Such an undertaking will have to deal with the slumbering passions of more than a hundred millions of people and find some way to loose the claw-hand of incontinence, bestiality, and moral leprosy from the throats of the third and fourth generations.

But when the records of human activity are charted under the exact scrutiny of analysis a priori, it will be found that civilization, or human progress, if you prefer, has moved forward and backward in a series of cycles, each beginning and ending with individual motives. It is axiomatic, also, that the individual must underwrite the collective welfare.

That is why it is contended that individual motives and incentives hold out the only latent promise of a large social service. Perhaps that does not constitute a pretty picture. For men generally try to shift responsibility for the things they don't like. That is why there is so much talk about business administration in government affairs and government operation of this and that in the interest of all the people. Men are simply trying to get from under a load they ought to carry, a load which, in the last analysis, they must individually carry. It's so much easier to curse the government because it is the representative of all the people, than it is to do the thing itself.

There is nothing in that. The medical profession is a social unit. Because of its inherent characteristics it is being constantly called upon to give exact account of its doings, its limitations, its possibilities. Assuredly, it has shaped its course to fit surrounding conditions. It has had to do that. But it should not be criticised unduly for doing the self-same thing every other social unit has done, and is doing every day under the press of expediency.

The weaknesses of the medical profession are not exclusively its property. They can be observed any day, in business, in politics, in government. That is why men generally are coming to believe, in fact do believe, that society must evolve within itself new ideals, new standards, new methods—they recognize in a vague sort of way that all professions, all sciences, all business, not excepting political government, should proceed in an orderly manner toward the accomplishment of some definite, constructive purpose—toward the precise performance of a large social service. These are the birth-pains of a social mind.

Medical science lays very close to men's lives. It is not to be wondered at that it should be called upon for a large measure of performance, a comprehensive understanding of its opportunities and purposes. What men are really trying to say is that medical incongruities must be eliminated, that the science of medicine must comprehend the science of health; that its purpose is prevention as well as cure.

All this, because for every failure of medical science to function in the discharge of exact social standards, for every day lost by men and women through preventable causes, the public pays an unjustified and unjustifiable toll. There is the inevitable conflict. Labor must justify its wage. Capital must justify its return. Business must justify its service and its charges. And the science of medicine must justify its conception of the national health according to the needs of all the people by deeds and not words.

These are the conflicting emotions with which Mr. Frank struggles. And in sheer desperation he grips his bootstraps with clenched hands in a su-

preme effort to lift himself bodily out of such an inglorious predicament. Let him speak for himself:

> "In the final summing up of the case, the length of time required in the preparation for the practice of medicine, the number and quality of men who serve upon medical faculties, the physical equipment of laboratories, and the like, are all to a greater or less degree, determined not by what the institution needs, but by what the institution can pay for. In a state based upon intelligence instead of upon expediency and drift, these things would be determined only by the health needs of the nation. However large the necessary funds they would be supplied by taxation and not wait upon the whims of philanthropists."

That is about as pure a piece of sophistry as it is possible to rig up. The question of expediency is always paramount in politics. A large majority of our reputable medical schools is state owned and operated. One of the very real problems which confronts the medical profession today is the question of convincing politicians that there is need for adequate appropriation to make those schools somewhere nearly responsive to our health needs. With political higgling fresh in their minds, the members of the medical profession will not view with any degree of assurance Mr. Frank's appeal to their cupidity in the following words:

> "This system of yearly service would, many doctors believe, mean a larger average income for doctors and a general saving for the people."

There is, of course, something grandiloquent about such a statement. The profession will get more, and the people pay less, a happy arrangement surely, if true.

Obviously, there is nothing in either of these propositions except the battered makeshift of a broken promise. What Mr. Frank sees, of course, is the undisciplined strut of a lot of men in every walk of life, men who might be made to serve the social welfare more fully by the introduction of some order and purpose into their contact with human affairs. What he does not see, however, is the impossibility, the utter futility of imposing any confidence in the collective mind as the guardian angel of our lives, and health and happiness, until the individual minds which constitute it have developed a social character. It is simply one of those vicious circles which wastes its force in a struggle to super-impose the will of the few on the lives and habits of the many.

That is probably the reason why Mr. Frank proposes putting all doctors on the payroll of the state. It is always easy, when writing an indictment of existing conditions, to suggest that the cure may be found in the mere addition of a few paltry millions of dollars to an already suffocating tax burden. That is false logic—at best a mortgage of the future plastered on the present with interest thrice compounded in circumlocution, in inefficiency, and in disinterested administration. In laying taxes, there is something so big, so inclusive, that the average person finds it impossible to resist an impulse to demonstrate that he is everything but a misanthropist. He wallows in the splendor of public spiritedness until his own tax bill arrives: then turns to rend the government instead of cursing his own folly—about as ludicrous a performance as can be conjured by the most imaginative mind.

Taxes are the constant nemesis of even our most astute political statesman. Government operation of public utilities, shipping board excesses runing into the billions, aircraft follies whose stench was so great the whole truth will never be known to a voting public, and dozens of other spoliage systems ad nauseum—all fresh in the minds of thinking people, make one hesitate about committing the national health into the hands of a po-

litical organization. But it would be taking undue advantage of Mr. Frank to drain the last drop of bitterness from the cup of wormwood and gall from which the whole world is drinking its excesses in the form of taxes. That may be left to the people of Russia. It is sufficient to call attention to the incident social loss in stifled enterprise, thwarted ambition, and collective iniquity, a loss which in some way the medical profession must find the power to retrieve out of the present physical and mental social waste.

Having declared the pages of Century Magazine open to a full and free discussion of this matter much may reasonably be expected from Mr. Frank in future.

Mindful of its public responsibility as an instrumentality of the medical profession, The Journal bespeaks Mr. Frank's sincere coöperation in proving out a national health program which will be both comprehensive and statesmanlike, and which will not jeopardize the public welfare by unsexing the medical profession.

National Board Medical Examiners

THE National Board of Medical Examiners has just completed the first five years work and with it the trial period of its usefulness. The principle which this board has stood for, namely, the establishment of a thorough test of fitness to practice medicine which might safely be accepted throughout this country and abroad, has been widely accepted. Since this board was organized by Dr. W. L. Rodman, in 1915, eleven examinations have been held. These examinations have been conducted on the plan of holding at one sitting, a written, practical and clinical test for candidates with certain qualifications, namely, a four-year highschool course, two years of college work, including one year of physics, chemistry, and biology, graduation from a class A medical school and one years internship in an acceptable hospital. These examinations have covered all the subjects of the medical school curriculum and have been conducted by members of the board with members of the profession resident in the place of examination appointed to help them. Such examinations have been held in Washington, Philadelphia, New York City, Boston, Chicago, St. Louis, Rochester (Minnesota) and Minneapolis. During the war a combined examination was held at Fort Oglethorpe and Fort Riley. There have been 325 candidates examined, of whom 269 have passed and been granted certificates.

Starting with the endorsement of the Council on Medical Education of the American Medical Association, American Medical College Association and various sectional medical societies, the recognition of the Army, Navy and Public Health Service Medical Corps of the United States and certain State Boards of Medican Examiners, the certificate is now recognized. Also by twenty states as follows: Alabama, Arizona, Colorado, Delaware, Florida, Georgia, Idaho, Iowa, Kentucky, Maryland, Minnesota, Nebraska, New Hampshire, New Jersey, North Carolina, North Dakota, Pennsylvania, Rhode Island, Vermont and Virginia, the Conjoint Board of England, the Triple Qualification Board of Scotland, the American College of Surgeons and the Mayo Foundation of the University of Minnesota.

There has been such a wide-spread demand for an opportunity to secure this certificate by examination, that the board has now adopted and will put into effect at once, the following plan: Part 1, to consist of a written examination in the six fundamental medical sciences: anatomy, including histology and embryology; physiology, physiological chemistry, general pathology, bacteriology, materia med-

ica and pharmacology. Part 2, to consist of a written examination in the four following subjects: medicine, including pediatrics, neuropsychiatry, and therapeutics; surgery, including applied anatomy, surgical pathology and surgical specialties; obstetrics and gynecology; public health, including hygiene and medical jurisprudence. Part 3, to consist of a practical examination in each of the following four subjects: clinical medicine, including medical pathology, applied physiology, clinical chemistry, clinical microscopy and dermatology; clinical surgery, including applied anatomy, surgical pathology, operative surgery, and the surgical specialties of the diseases of the eye, ear, nose and throat; obstetrics and gynecology; public health, including sanitary bacteriology and the communicable diseases.

Parts 1 and 2 will be conducted as written examinations in class A medical schools and Part 3 will be entirely practical and clinical. In order to facilitate the carrying out of Part 3, subsidiary boards will be appointed in the following cities: Boston, New York, Philadelphia, Minneapolis, Iowa City, San Francisco, Denver, New Orleans, Baltimore Galveston, Cleveland, St. Louis, Chicago, Washington, D. C., and Nashville, and these boards will function under the direction of the National Board. The fee of $25.00 for the first part $25.00 for the second part and $50.00 for the third part will be charged. In order to help the board the Carnegie Foundation has appropriate $100,000.00 over a period of five years.

At the annual meeting held June 13th, of this year in Boston, the following officers were elected: M. W. Ireland, Surgeon General, President; J. S. Rodman, M. D., Secretary-Treasurer; E. S. Elwood, Managing Director.

Mr. Elwood will personally visit all Class A schools during the college year to further explain the examination, etc., to those interested. Further information may be had from the Secretary-Treasurer, Medical Arts Building Philadelphia.

Errata

The article appearing in the September, 1921, Journal of Radiology entitled, .'The History and Development of Radium Therapy," by Dr. C. H. Viol, should have stated that this paper was prepared in June of 1920 and publication was delayed until September, 1921.

Official Program Annual Meeting

Chicago, December 7, 8, 9, 10—Sherman Hotel

Announcements

There will be a general business session at 7:00 P. M. December 6, at the Sherman Hotel. Reports of officers, counselors and committees.

Wednesday Morning, December 7th

9:00—Short Business Session.

9:30—"The Planning and Equipment of a Modern X-Ray Laboratory," Dr. Hugh J. Means, Columbus, Ohio.

10:00—"The Radiologist in Small Communities," Dr. Ulysses S. Kann, Binghamton, N. Y.

10:30—"What is X-Ray Diagnosis," Dr. Donald S. Childs, Syracuse, N. Y.

11:00—"The Standardization of Absorptive Powers of the X-Ray by Salts of the Various Metals," Dr. Leoen J. Menville, New Orleans, La.

11:30—"Team Work With the Pathologist," Dr. H. E. Robertson, University of Minnesota.

Wednesday Afternoon, December 7th

1:30—"Organ Stimulation by Roentgen Rays," Dr. Wm. F. Petersen, University of Illinois, Chicago.
2:00—"Differential Microscopical Diagnosis of the Effects of Irradiation," Dr. A. S. Warthin, University of Michigan.
2:30—"The Biological Reaction of the More Penetrating Radiations," Dr. Guilleminot (Faculté de Médicine, Paris).
3:00—"Some Observations on the Systemic Effects of High Voltage Roentgen Irradiation," Dr. James Thos. Case.
3:30—"Biological Determination of X-Ray Dosage," Dr. Francis Carter Wood, Director Crocker Institute, New York City.
4:00—"The Effects of X-Rays on Inherited Characteristics. Practicability Demonstrated by Record of 100 Cases," Dr. James W. Mavor, Ph. D., Schenectady, N. Y.
4:30—"Radium and X-Ray Therapy in Malignancy: Indications, Contra-Indications, Limitations and Recent Developments," Dr. A. U. Desjardins, Mayo Clinic, Rochester, Minnesota.
5:00—"Preoperative Radiation Treatment of Malignancy," Dr. Carl Ballard, Omaha, Nebraska.

Wednesday Evening, December 7th

Joint meeting with Cook County Medical Society and Chicago Roentgen Society.

Thursday Morning, December 8th

9:00—"The Use of Radium Needles in Treatment of Cancer," Dr. Chas. F. F. Bowen, Columbus, Ohio.
9:30—"Treatment of Carcinoma of the Breast by Surface Application of Roentgen Rays and Radium, Supplemented by Imbedding Radium," Dr. Russell H. Boggs, Pittsburgh, Pa.
10:00—"The Penetration of X-Ray into Tissues," Dr. Henry Schmitz.
10:30—"Treatment of Neoplasms of the Tonsil," Dr. Douglas Quick, New York City.
11:00—"Focal Infection of the Throat by X-Ray as Compared With Surgical Removal of Tonsils and Adenoids," Dr. W. D. Witherbee, New York City.
11:30—"Radiotherapy of Diseased Tonsils," Dr. Robt. H. Lafferty, Charlotte, North Carolina.

Thursday Afternoon, December 8th

1.30—"The X-Ray Treatment of Tonsils With the Conjoint Use of Ultra-Violet Radiation," Dr. A. J. Pacini, Washington, D. C.
2:00—"Clinical Observations in Radiotherapy of Uterine Cancer," Drs. Donaldson & Knappenberger, Kansas City, Mo.
2:30—"Roentgen Treatment of Malignant Tumors," Dr. Roscoe Smith, Lincoln, Neb.
3:00—"Our Method of Roentgen Deep Therapy of Malignant Tumors," Dr. Wintz, Erlangen, Germany.
3:30—"Some of the Less Common Uses for X-Ray Therapy," Dr. G. E. Richards, Toronto General Hospital.
4:00—"Unsolved Problems and Debatable Points in Short-Wave Therapy," Dr. Leo E. Pariseau, Montreal, Quebec, Canada.
4:30—"Preliminary Report on Results Obtained in Heavily Filtered X-Ray Treatments of Inoperable and Recurrent Cancer of the Female Breast," Dr. E. H. Merritt.
5:00—"The Treatment of Epithelioma of the Lip by Electro-Coagulation and Radiation," Dr. Geo. Pfahler.

Thursday Evening, December 8th

Banquet and conferring of Honorary Degrees.

Friday Morning, December 9th

9:00—Business Session.

9:30—"Positional Anomalies of the Gastro-Intestinal Tract," Dr. M. J. Hubeny, Chicago, Ill.

10:00—"Duodenal Bulb Deformity in Relation to Symptoms and Chemistry of the Gastric Juice," Dr. A. W. Crane, Kalamazoo, Mich.

10:30—"Some Errors in the Roentgen Diagnosis of Duodenal Ulcer," Dr. Russel D. Carman, Rochester, Minn.

11:00—"Diagnosis and Classification of Gastric Ulcers," Dr. Lewis Gregory Cole, New York City, N. Y.

11:30—"The Effect of Chronic Appendicitis on Intestinal Motility," Dr. A. W. Erskine, Cedar Rapids, Ia.

Friday Afternoon, December 9th

1:30—Business Session.

2:00—"The Treatment of Fibromata of Uterus by Roentgen Ray," Dr. Mary Elizabeth Hanks, Chicago, Ill.

2:30—"Control of X-Ray Therapy in Hyperthyroidism by Basal Metabolism Test," Dr. H. M. Jones, University of Illinois.

3:00—"Basal Metabolism, Hyperthyroidism and Radiotherapy," Dr. Harvey W. Van Allen, Springfield, Mass.

3:30—"The Physical Foundation of Deep Therapy," Dr. Vierheller, Frankfort University.

4:00—"Present Deep Therapy Construction Problems," Duane and Morrison.

4:30—"Dosage Factors in Roentgen Therapy," Dr. H. J. Ulmon, Santa Barbara, Cal.

Friday Evening, December 9th

8:00—"Development of Carpal Bones in the Feeble Minded," Dr. Rollin H. Stevens, Detroit, Mich.

8:30—"A Study of Hilus Pneumonia by Radiographic Examination," Dr. LeRoy Sante, St. Louis, Mo.

9:00—"The Information Gained from the Chest Examination of One Hundred Infants," Dr. Fred Hodges, Richmond, Va.

9:30—"Subphrenic Abscesses and Their Roentgenological Evidence," Dr. Leonard G. Crosby, Denver, Colo.

Saturday Morning, December 10th

9:00—Subject to be Announced. Dr. W. W. Wasson, Denver, Colo.

9:30—"High Speed Radiography," Dr. W. D. Coolidge, Ph. D., Schenectady New York.

10:00—"Pneumoperitoneum of the Female Pelvis," Dr. James G. Van Zwaluwenburg, University of Michigan.

10:30—"A Dental Phase of Radiology," Dr. Byron Darling, New York City.

11:00—"Urological Cases," Dr. E. C. Koenig, Buffalo, N. Y.

11:30—"The Gall Bladder," Dr. Robert A. Arens, Chicago, Ill.

DEPARTMENT OF TECHNIQUE

Chest Radiography

IT would seem proper that before one begins the study of the pathology of the chest, he should first have an accurate technique. The same analogy would apply as in the physical examination of the chest without a knowledge of the various problems entering into it. I feel that the finest detail is necessary; and yet, some criticise by saying that we can have too much detail. My answer is, "If we are to study anything more than gross pathology, we must show all possible normal anatomy,"

There are numerous problems concerned with chest radiography, many of which I have attempted to describe in previous papers, and I will not enter into a discussion of those again at this time. May it suffice to say that all the factors which I shall describe, appear to be necessary.

In building up the technique, the first consideration should be given to the length of exposure. This should be between one-tenth and one-twentieth of a second, and it is now practical with the large equipments to use one-tenth as a routine.

Certain men have lately recommended one-fourth of a second—but if it is desirable to cut the exposure from two or three seconds to one-fourth of a second, why not go as far as possible with the present apparatus and at least approach the ideal? This time factor is especially necessary in children, and almost equally so in adults if we are to diagnose early cases.

Having established the time factor of one-tenth second as our basis for work, we are now ready for the other factors, and it now becomes necessary to select an emulsion upon which to register our radiograph in the shortest possible time. This requirement seems to be best filled by the duplitized films and the double intensifying screens, I do not care to enter into a discussion of films versus plates, but it does not seem that plates can meet the present requirements. The objections to screens in chest radiography are a heresy of the past.

Having selected our emulsion and with a definite time, the problem is now to pass the rays through the chest in such quantities as to properly expose the emulsion. This brings into question the exposure chart, and I do not believe that it is practical to give an exposure chart that will be accurate for all laboratories. We are all using different transformers with varying degrees of efficiency, with more or less loss from wires, and with tubes at varying distances from the transformer.

But there are factors entering into the amount of current which we can establish. All chests should be measured, as each inch of tissue requires a certain amount of current, and the eye is not accurate enough to estimate the size. By recording our measurements, with the exposure, and quality of the resulting film we can soon learn the proper exposure for any chest.

The tube is the apparatus to deliver certain rays through a certain thickness of chest and to register upon a known film in a definite length of time. It must be selected with care. There are various kinds of tubes, and various properties have been attributed to the various kinds; but there

is only one really important point, and that is the focal spot. It is the lens of our camera.

The focal spot should be photographed, and it is much better to think of it in terms of millimeters-diameter, rather than fine, medium, and broad focus tubes. For instance, a fine focus Standard Type Coolidge tube has about the same diameter of focal spot as a broad focus Radiator Type Coolidge tube. Having tested our tube, we will find that an object six inches from the plate will be cast in sharp relief with the tube at varying distances from the plate, depending upon the size of the focal spot. Having measured our patient, we will then find that a chest of a certain depth will require a tube of a certain diameter of focal spot to be at a definite distance from the plate. This tube-plate distance will vary from thirty inches to five feet, depending upon the depth of the chest and the focal spot used.

Having selected our tube, and having the tube at a distance from the plate as regulated by the diameter of the focal spot and the anterior-posterior diameter of the patient's chest, and having the factors established as to the film and time; it now becomes a question of setting the machine for the necessary voltage and milliamperage to properly expose the emulsion. The milliamperage and voltage will have to balance, remembering that the lower penetration and the higher milliamperage gives a greater latitude, and usually tends to better contrast. The ordinary tube will stand this strain for a reasonable period of time.

By following the points outlined above, I feel it is possible for anyone to develop a standard technique suitable for his own use, and one which he can use routinely. The criterion of his accuracy will be the detail shown upon the film.

Plates are made or spoiled in the dark room, and this phase of the technique must not be overlooked. Over-development will cut out the necessary tissue detail, while under-development fails to bring out the desirable contrasts. Old chemicals and incomplete washing will make a short exposure impossible.

The position of the patient should, as a routine, be in the upright, though at times we may wish both prone and upright positions. The fluoroscope will be of aid in this respect, and often a special angle will be desired. Instruction of the patient as to his breathing and general coöperation adds considerably to the final result.

Finally, having produced the proper negative, we now come to the technique of studying it. We are dealing with the portrayal of the normal and pathological anatomy upon an x-ray film, and it is now beyond the scope of a technician, just as the transposing of stethoscopic signs into terms of pathology is beyond the scope of a technician.

Time and care are esesntial to the proper study of a chest radiograph, and I hardly need to add that it should be stereoscopic. Beginning with the normal anatomy, we observe the changes over into the pathological, just as the pathologist studies the change from the normal cells into the pathological proliferation. Having the proper film, by careful and prolonged study and observation of the bronchial and parenchymal structures we may hope in time to establish a basis of the pathology of the chest.

W. WALTER WASSON,
Denver, Colo.

Dental Film Holder

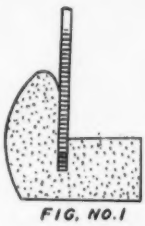
IN presenting this appliance I wish to state that it is not original with me, but I have been using it for the last year and find that I get very good results with it. Also it is easier for the patient than the old finger-holding

method. Dr. J. DeVoine Guyot, in presenting his method in the August number of the Journal of Radiology, states that he is still using the old finger method for holding the film in the lower jaw. This appliance is equally good in either the upper or lower jaw.

The appliance consists of a small right-angle block of wood 2 centimeters wide and 2 centimeters high and 1½ centimeter long. The shape of the block is shown in the illustrations. There is a slot, for the insertion of the side of the film, cut in one side. The size of this slot will depend on whether the Buck or the Eastman film is used. The upper angle of the block which comes behind the film is made rounded so that the film in the roof of the mouth will not make a sharp angle but will better conform to the palate.

In using this holder the film is placed in the slot with the back to the vertical portion. The film is then placed in the patient's mouth as usual and the patient told to close his teeth on the horizontal part. This holds the film in position better than any other method that I have tried.

These blocks may be made up in a long strip and then cut to the desired length and in this way the cost need be but very little.



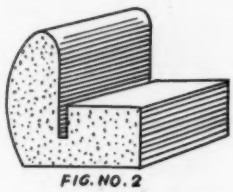


Fig. No. 1—End view showing the film in place.

Fig. No. 2—To show the slot across one side.

F. B. SHELDON,
Fresno, Cal.

NEW EQUIPMENT

International Precision X-Ray Apparatus

SUCH a great portion of the average practice of the medical radiologist specializing in deep therapy is of cancerous character, that the announcement of a precision x-ray apparatus by the International X-Ray Corporation holds an enormous interest because of the special features embodied in its construction.

For the benefit of those less familiar with the principle of deep therapy, it may be well to state two or three facts.

1. The higher the voltage the shorter the wave length.
2. The shorter the wave length, the harder the x-rays deflected from the target in the tube.
3. The harder the x-rays used, the further the tube may be set from the body, with greater penetration at the seat of malignancy and less possibility of burning the skin.

Thus stated, the reason for the demand by the radiological profession for apparatus with high potential capacity is obvious. Until lately, the highest average possible voltage that could be delivered ran somewhere around 138,000. The difficulty of mass dosage in deep seated malignancy without excessive erythema has been one of the very real problems of the profession. And since the treatment of skin cancer has been so successful, because in that class of cases, it has been possible to deliver sufficient dosage to destroy the growth, the question of effective treatment of deep seated malignancy has been somewhat discouraging. The answer seemed especially elusive unless voltage could be materially increased. For a long time that appeared to be a baffling situation. Manufacturers were unabe to develop machines capable of voltages in the neighborhood of 200,000.. The static accumulation, or more familiarly the "surge", stood out as a manufacturing bogey by burning out the transformer.

During the present year, however, the American Institute of Electrical Engineers completed its research and announced specific formulae for the application of the sphere gap principle to high potential apparatus; in other words, the standardization rules of that organization specify that it is permissible to use needle or point gaps on machines of 70 kilovolt capacity and the use of sphere gaps on machines above that capacity.

Following the principle of sphere gap construction clear through, the International X-Ray Corporation has developed a method of rectification, consisting of spheres and segmental toroids. Theoretically, it bears evidence of being a very decided improvement in mechanical construction of high potential x-ray apparatus, and which, if it works out in practice measurably with its promise, will aid medical radiologists in treating deep seated malignancies much more successfully than they are now able to do.

We have not enjoyed the opportunity of observing this particular piece of apparatus under test. However, it has been scrutinized very carefully by a number of the best electrical engineers and physicists in the country and pronounced as remarkably efficient. For the moment, we shall be obliged to rely on their judgment. But since the International Corporation is perfectly willing to enter into a written agreement with

each purchaser of this apparatus guaranteeing the transformer for a period of two years, it is safe to assume, at least, that that company has conducted break-down tests to the point where it is perfectly willing to stake its future on the machine it is offering the profession.

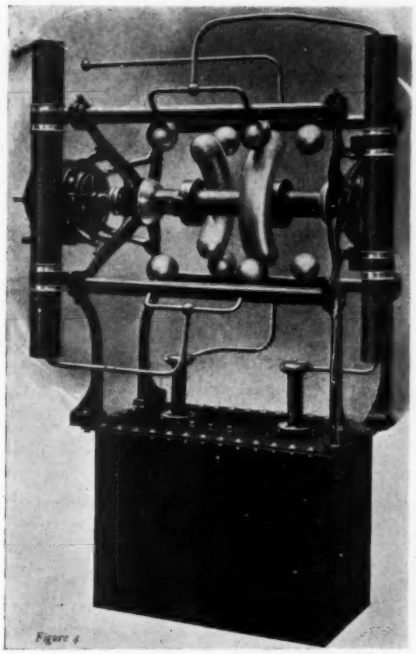
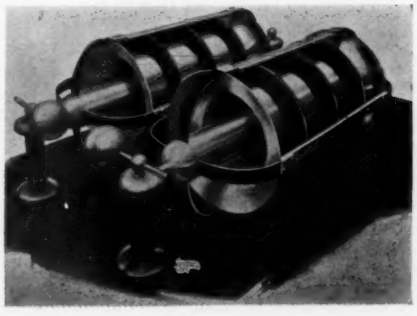


Figure 4

Briefly, it is claimed the sphere and segmental toroid method of construction which will be observed in the illustration entirely eliminates corona. There are eight spheres, all stationary. Two toroids of such segment to make it unnecessary to conduct any current through the shaft as is done in nearly all point gap rectifiers, are suspended from a revolving axis. Their respective points of suspension are at opposite position in the circumference of the revolution. The spheres are fixed in the four corners of a perfect square projected. Each of the segmental toroids operates within the circumference of the square of four spheres. The toroids are set at opposite ends of the revolving axis so there is no danger of arcing between the spheres. As the toroids revolve they come in contact with negative and positive spheres alternately. By this method, a constant flow of unidirectional current to the tube is maintained. There will always be room for argument concerning what actually happens in the sphere method of rectification, e. g., whether there is complete absence of static or whether the segmental toroids operating in the field of inducted energy following the actual spark over, pick up the static and carry it across to the next point of contact. What actually happens is not perhaps material to the radiologist so long as the machine operates successfully.

There are certain other features of this apparatus which it is believed should be commented on.

First: Two air condensors mounted on top of the x-ray machine cabinet. These condensors are built according to the specifications adopted by the American Institute of Electrical Engineers while doing research work on the sphere gap problem, and as nearly as can be determined from a study of the literature received, tie into the line in such a way as to protect the transformer against line fluctuation and possible surge, as well as dissipate the heat incident to continuous operation under extremely high voltage. See the accompanying illustration.



It will be noticed that there is a sphere gap between these two air condensors. The reason for this is given to provide a limit gap for the machine, and for the purpose of checking one crest measurement against the other. In passing, it may be of interest to know that this form of precision air condensor was devised by Messrs. Fortescue and Chubb under the supervision of the American Institute to enable them to correctly calibrate the sphere gap.

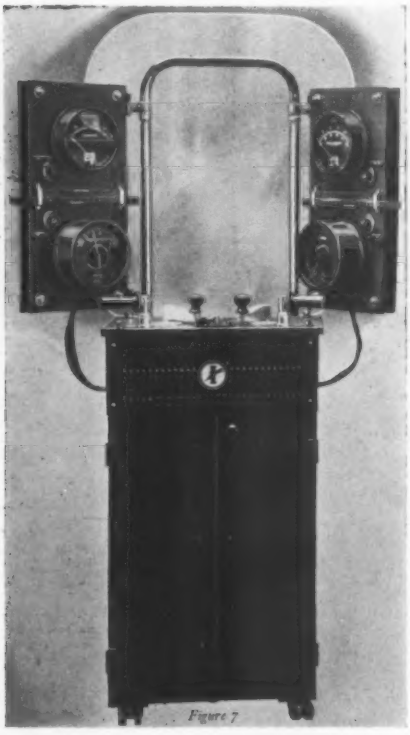


Figure 7

Second: The control board and meter panels are shown in the third illustration. The kilovoltmeter equipment appears on the left panel, and the ground potential milliameter and filament ammeter at ground potential may be observed on the panel to the right.

Conceding for the purpose of this discussion, that the International Precision Apparatus will actually accomplish everything in practice that is claimed for it in theory (and frankly, there is every reason for believing that it will work out satisfactorily in the hands of the profession because it is manufactured and marketed by a concern of extremely good repute) it brings into being one of the most radical achievements in electrical construction occurring in the science of x-rays for a long time.

Physicists have recognized for a long time that it is necessary to read the actual potential of the secondaries of x-ray apparatus in order to accurately measure dosage. The International machine measures this secondary potential by an actual registering voltmeter calibrated in direct reading kilovolts. This meter, it is claimed, is within one-half of one per cent. efficient so that no attention need be given to atmospheric pressures and other variables.

The action of this machine in actual field service and the success of radiologists as well as the manufacturer in demonstrating its advantages in deep therapy will be followed with manifest interest, first, because it is a complete application of the theory of precise measurement of high potential energy in the science of x-rays, and second, because it promises so much in a therapeutic way.

This machine will be on exhibit at the annual meeting in Chicago next month and will doubtless prove one of the pieces of apparatus of particular interest.

A Correction

MR. MONTFORD MORRISON, Consulting Engineer of the International X-Ray Corporation of New York, calls our attention to an inadvertent misstatement appearing in our discussing of the Victor Sphere Gap.

The statement to which he alludes was:

"A sphere gap measures peak voltage while a point gap measures average voltage."

The latter part of this statement, i. e.:

"While a point gap measures average voltage," is incorrect.

All spark gaps have what is called time lag, that is to say, the voltage rises above the true spark-over value somewhat before spark-over actually occurs. This time lag is much longer in the spark gap than in the sphere gap, but the reading bears no relation whatever to what is known to engineers as the average voltage value.

The average value of a voltage cannot be determined by any measurement whatever until an entire half cycle has elapsed. Spark gaps cannot possibly spark-over at the end of the declining side of the half cycle and therefore to read the average of a wave starting at zero and ending at zero would be impossible by any gap measurement.

While this is purely a technical criticism it is worthy of publication because The Journal has no desire to mislead or misinform its readers nor becloud the discussion of such important questions with incorrect principles or a misapprehension of the facts. Such criticisms are very much appreciated and it affords us pleasure to accord Mr. Morrison the credit for setting us all right on this proposition.

Victor Stabilized Fluoroscopic and Radiographic Unit

THERE is considerable virtue in any appliance which stabilizes current flow in fluoroscopy and radiographic work. The Victor-Kearsley Stabilizer has proven so valuable in connection with the larger apparatus that the Victor Corporation has adapted the principle to the construction of a stabilized Fluoroscopic and Radiographic unit. With the stabilizer in the circuit the operator is not annoyed by voltage fluctuations which so affect tube current as to make specific technique more or less impossible.

With the stabilizer in the line the operator has perfect control of tube current at either the radiographic or fluoroscopic apparatus by means of a control stand which embodies auto-transformer control, filament control, circuit breaker, milliamperemeter, line volt meter, hand lever switch and foot lever.

The auto-transformer offers an unusual refinement of control, enabling the operator to select any back-up spark within the range of three to five inches.

The circuit breaker is another important feature, the design of which is to protect both operator and patient against dangerous shocks from accidental contact with the high tension current; at the same time protecting the apparatus itself against burn-outs.

The high tension transformer follows in design the same principles as are applied in the larger Victor X-Ray transformers, being of the closed core, oil-immersed type. It can be mounted on the wall out of the way, on the floor, or wherever greatest convenience demands.

The control stand being mounted on castors, can be moved about to the position most practical for the operator, in proximity to the radiographic apparatus or to the fluoroscopic apparatus. There is also provision by which a foot switch can be connected with extended cable to the control stand, thus permitting the operator to turn the current on and off while remote from the control stand.

The range of service offered in this outfit suggests its use in both the specialized laboratory and the physician's office for diagnostic work. It is practical and economical and is especially in demand where conservation of space is essential.

ABSTRACTS AND REVIEWS

Tratado Practico De Radiologia. Dr. Carlos Heuser, Buenos Aires, Argentina, South America. La Semana Medica, Imp. De Obras De E. Spinelli, 1921.

THIS book is, as the name implies, a practical treatise of radiology containing two hundred illustrations and four color plates. The author takes up the subject in a practical way which is suitable for reference work, especially for those who are younger in the profesison.

The book is profusely illustrated, showing all the different angles and positions which are described by the author for use There are several illustrations showing little schemes original with the author for making the work easy and more accurate. Reference is made to the literature of all nationalities and descriptive material illustrating various technical devices and points in technique throughout the world.

The illustrations made from radiograms are practically all in the positive. Some of them might be open to criticism due to the fact that they have been retouched.

Anyone practicing radiology will find the book of great reference value.

A. F. TYLER.

The Combined Examination of the Urinary Tract by the Urologist and the Roentgenologist. Howard E. Ashbury, M. D., F. A. C. S., and Albert E. Goldstein, Baltimore, Md. Southern Med. Jour., Sept., 1921.

THE essay is based upon the study of 250 cases that came to the Urological Clinic of the Hebrew Hospital during the past two years. in which a combined study was possible; it outlines the method of procedure and basis of interpretation. wich saves time, the annovance of repeated cystoscopies, and enables a prompt and accurate visualization of existing pathology. The deductions offer a fair example of the limitations of the two methods individually and a practical idea of the value of the combined study insofar as the reduction of the percentage of failures is concerned and the large percentage of proven correct diagnosis.

In all the cases studied, plain roentgenograms were made of the entire urinary tract, and then the cases were studied urologically, using all recognized methods of procedure.

Capacity in all cases was first determined with sterile water or salt solution. The administration into the renal pelvis of opaque solutions should be performed by competent urologists, who may use either the syringe or the gravity method, the syringe being used in these cases.

In the interpretation of the plain x-ray in urological cases, they necessarily divide themselves into those giving positive x-ray findings and those giving no radiable evidence of disease on the plain x-ray plate; the latter far exceeds the former, and include a large percentage or non-radiable calculi, of uric acid composition. These are located principally in the bladder.

Of the 250 cases studied, 152 or 60.8 per cent. demonstrated pathological lesions in the urinary tract, and ninety-eight or 39.2 per cent. demonstrated no urological lesions. The plain x-ray gave evidence of disease in fifty or 32.7 per cent.

Out of a total of forty-six urinary calculi, forty-one or 89.1 per cent. gave evidence on the plain x-ray plate; five cases in which no evidence of shadow was seen on the plain x-ray plate were vesical calculi and were diagnosed by cystoscopy and cystography. It is interesting to note that all the ureteral calculi that were diagnosed gave a definite shadow in the plain x-ray plate which is contrary to the published statistics.

One hundred and forty-eight cases or 97.3 per cent. gave evidence of disease by the urological method. One hundred and four or 61.7 per cent. were positive from the urological findings and forty-four or 38.3 per cent. were doubtful. The forty-four doubtful cases were finally diagnosed by the combined method, leaving only four cases as undiagnosed.

The entire 152 cases which presented pathology were verified by an operation of some character. In the four undiagnosed cases exploratory

operations were advised, and pathological conditions were demonstrated at the operation.

Conclusions

1. By the combined method of examination our results show only 1.6 per cent. of failures.
2. Urological lesions were demonstrated frequently by aid of the x-ray where they were doubtful in the two examinations individually.
3. In over 50 per cent. of the cases in which the plain x-ray was negative pathological conditions were found by the combined method of examination.
4. The plain x-ray findings should in all cases be verified by the urologist before a conclusive diagnosis is given.
5. The combined method is the ideal procedure for the diagnosis of urological conditions.

A New Form of Stereo-Fluoroscope. A. M. Tyndall, D. Sc., (Prof. Physics University of Bristol) and E. G. Hill, M. Sc., (Bristol) in Journal of Roentgen Society (British); Vol. 17, No. 68, Page 122.

IN this device the authors have created a practical stereo-fluoroscope which requires but one tube and that may be either the ordinary gas or Coolidge tube. The principle is that instead of two separate tubes or a single tube with two targets, this ordinary tube with a single target is made to occupy two positions under continuous excitation. This is accomplished by mounting the tube on a suitable holder which is rocked to and fro actuated by an eccentric on a revolving disc. The excursion of the tube is made variable but the most efficient amptitude was determined as being about one inch. The disc is energized by an electric motor and the speed does not appear to be important: as low as 10 r. p. s. was quite satisfactory. Onto the shaft that moves the tube a geared wheel is attached, which is connected by a chain drive to a revolving shutter. The disc of this revolving shutter is of a diameter of four and one-half inches and from it is removed a segment equal to one-quarter of the disc. The observer looks through two "eye holes" and with this shutter revolving the right and left eye is alternately covered and free; this in synchronism with the position and the image on the screen, as is determined the position of the target. A chain drive is considered essential to prevent these factors getting out of phase with a consequent loss of the stereoscopic effect. The authors state that the device is simple, cheap, and satisfactory.

L. K. POYNTZ.

X-Ray Treatment of Two Cases of Otosclerosis. J. H. Douglas Webster, M. D., M. R. C. P. E. (London, England), in British Journal Archives of Radiology and Electrotherapeutics, No. 253, Aug., 1921.

OTOSCLEROSIS is one of the most difficult and obscure problems of modern medicine. Although over ten theories have been advanced in explanation of it, yet the real cause is unknown or at least disputed. Because of the chronicity of the malady a true estimate of the value of any method of treatment is difficult. The majority of the cases, being advanced, show permanent bone changes at the stapes-foot and therefore are quite unsuitable for radiotherapy. It is only in early cases that results may be looked for. Being of such an insidious nature, however, and almost symptomless in the early stages, few cases are detected early enough. The writer then reviews the various theories and alleged causes that are claimed to precipitate the condition. However, it would seem that the association with osteo-malacia and rickets is rather common. After a somewhat exhaustive description of the pathology, he summarizes it "The main point for the present purpose is that the pathology of the condition suggests that in the early stages it should be amenable to radiation treatment."

Jaulin in 1908 appears to have been the first to try radiation in otosclerosis and showed improvement in six of the ten cases treated. The difficulties of the technique are great. Professor Siebenman of Bâle has advocated treatment in both early and late cases: in the early cases as improvement can be hoped for, but the late cases to arrest the progress of the disease.

Because of the beneficial effects obtained by ovarian radiation in osteomalacia claimed by Wetterer, he suggests its use here, and while no glaring achievement is claimed, yet he argues if one could stop an otherwise inevitably progressive condition, this justifies the effort. He cites two cases, one a man of thirty-seven with a his tory of fifteen years in which the condition was arrested and the other a woman of twenty five who showed a

most gratifying improvement. The paper is completed by a rather extensive bibliography.

L. K. POYNTZ.

Some Effects of Radiotherapy Upon Fibrous Tissue. Reginald A. Morrell, M. R. C. S. (England), L. R. C. P. (Lon.) (London, England). British Journal Archives Radiology and Electrotherapeutics, No. 253, Aug. 1921, Page 78.

THE cases treated were ex-soldiers and as the whole hospital team watched them carefully, the results reported are authentic. The successes were due to the relief of the ill-effects of fibrous tissue formation formed chiefly as a result of operative procedure, rather than the original injury, therefore more amenable to treatment because of the fact that this fibrous tissue was not yet old. Too few cases have been treated to justify any generalizing, but sufficient to warrant further investigation, as radiotherapy can be made even more useful to the surgeon especially where post-operative sequelae are likely to be pain or limitation of movement or function because of the necessary extensive dissection of the subsequent fibrous tissue formation. He divides the cases into four groups and cites case histories to illustrate each group.

In the first division were scar formations subsequent to brachial-plexus injuries. In these cases cyanosis, numbness of the hands and fingers and limitation of movement of the shoulder were relieved by a series of four to six applications after physiotherapy had not been successful.

Group Two: Cases of involvement of the sciatic nerve. Following operation, nerve stretching, and galvanism, the symptoms were not relieved. After the first application there was relief in some of the cases although further applications gave still greater relief. Two failures are reported but both were fibrositis, presumably, from septic focus.

In group three were cases of tendons caught in scar tissue. Following surgical freeing they were rayed and the rapidity and degree of their relief appears to be rightly attributable to the raying, as similar cases not rayed showed less fssatiactory results.

In group four one case is cited of a painful nerve bulb and scar over the ulnar nerve. Two treatments gave relief. A third treatment was unfortunate in causing an undesired erythema which had no permanent ill-effects. The scar was left supple and there was no pain, even on deep pressure. Four other cases of painful superficial scars were not relieved by radiotherapy. However, they did respond to percussion with a rapidly vibrating interrupted faradic current.

He comments here that a certain depth of tissue seems essential for the securing of results with radiotherapy. The technique he uses is a 16-inch coil, a Coolidge tube passing 3 ma. with a 9-inch S. G., through 3 mm. of Al. at a 14-inch distance. The dose delivered to the skin was ½-B. as checked up by the Corbett-Tintometer. Treatments were given at intervals of three days.

L. K. POYNTZ.

The Radiography of Pictures. André Chéron (From the proceedings of the French Academy) from the Journal of the Roentgen Society (British), Vol. 17, No. 68, Page 120, July, 1921.

THE first investigation of pictures by means of the roentgen ray appears to have been attempted in Germany in about 1914. Following this, Heilbron of Amsterdam and the author (in France) have obtained some surprising results. To obtain a good radiograph of a painting there are two essentials. First, both the support and the "sizing" must be transparent. Second, a varying density of opacity of the pigments is also necessary. Usually, the backing being wood or canvas, is readily transparent in both ancient and modern paintings, but the old masters used a sizing comparatively transparent. Its composition appears to be chiefly calcium carbonate and glue, while in moderns the size is almost exclusively white lead with a greatly increased radiopacity. In the pigments white has always been of heavy mineral origin, chiefly lead or zinc, while bitumin and black are transparent to the rays, whereas in certain colors, formerly of mineral origin, the modern school has replaced these by vegetable or analine colors; for example, mader-root. The old pictures lend themselves more to radiography as they show the transparent backing with the contrasting pigments while a modern with an opaque backing and homogeneous colors, shows practically nothing. So that this method may provide a guide to the age and authenticity of a picture. It will also show

the nature and extent of any restorations, as it is almost certain that the pigments of the different periods will vary sufficiently to allow of their detection, but possibly the most interesting is the light that is thrown on the genesis of the picture; as modified or completely changed by the author during this creation.

L. K. POYNTZ.

Notes on Certain Lesions of Bone. Walter Overend, M. D., and T. Dallas Overend, B. A., (Oxon) M. R. C. S., L. R. C. P., in British Journal Archives of Radiology and Electrotherapeutics, No. 253, August, 1921.

FIVE interesting cases are described and illustrated by seven radiographs. The first, a boy of eight, received an injury to his right arm and was sent for examination of a hard swelling of the humerus which was considered probably a sarcoma. Radiograms showed a bone tumor with a central opacity with many opaque lines radiating from it and interlacing. The radiological diagnosis of calcifying chondroma was made. A section later confirmed this x-ray diagnosis.

The second case: A boy of ten developed a fusiform swelling of the lower right fibula following a kick six weeks previous. A clinical diagnosis of tuberculosis was made. The radiographs showed the shaft of the fibula enveloped in a sheath of periostitis more than double the width of the normal bone. There was excessively marked irregularity of the edge over an extent of about three inches. X-ray diagnosis of congenital syphilis was made, or a possible periosteal sarcoma. The clinical tests indicated syphilis and the therapeutic test was applied, which confirmed the diagnosis of syphilis and re-examination some weeks later showed a disappearance of the irregularity, but the periostitis persisted. The author comments that such excessive periostitis in children is typical of congenital syphilis.

Case three was that of a man fifty-eight years of age sent in with a provisional diagnosis of periosteal sarcoma. Radiographic examination showed a tibia characteristically bent with a chronically ossifying periostitis with probably cyst formation in the upper tibia. An x-ray diagnosis of osteitis deformans of Paget's was made.

Case four was an early case showing a similar pathology. Here the author comments on the etiology of Paget's disease and stated that radiological examination has not found any change in the dimension of the pituitary fossa in osteitis-deformans, although the clinoid process may be thickened. The cause is still obscure, and may be from focal infection, as from pyorrhoea or a specific infection. The present case showed focal infection of the teeth. The author refers to articles by Arbuthnot Lane, Robert Jones, and Frank Romer (Lancet, Jan. 8th and 15th, 1921), but these cases are of traumatic origin whereas true Paget's disease is of obscure origin.

Case five was a man of sixty-eight showing intermittent claudication although x-ray examination showed artheroma of the popiliteal and posterior tibial arteries. Relief was obtained by radiant heat.

L. K. POYNTZ.

Radium Technique in the Treatment of Malignant Diseases of the Skin. Douglas Quick, New York City. Archives Dermatology and Syphilology, Sept. 1921, p. 322.

THE literature on radium treatment of malignant diseases of the skin is abundant. This paper is written to describe the technique which has been built up in the Memorial Hospital in New York City. It is largely the work of Dr. H. H. Janeway.

Skin lesions are so accessible that they are easy to treat. The important factors to be considered are (1) the selection of proper filters, (2) the accurate approximation to the lesion, and (3) the dosage.

The pathology determines the kind of ray to be used. For practical purposes emanations are obtained in sealed capillary tubes. These are unfiltered or filtered, according to ray desired in the treatment. The bare or unfiltered tube permits the utilization of all the beta and gamma radiations. A tube of .2 mm. of aluminum removes only the softer beta rays and a few of the gamma; a silver tube removes nearly all of the beta rays and the softer gamma rays; a millimeter of platinum removes all of the beta and a large percentage of the softer gamma rays. These filters are not the only ones that can be used, but they are the most practical ones, and handle all types of skin lesions.

The conditions illustrating the use are lupus, vernal catarrh, new and small lesions, such as moles, papillo-

mata, or rodent ulcers. The ingenious use of adhesive, paraffin and modeling compound and other devices add to the adaptability of the emanation needles. The numerous methods to accomplish the most crossfiring protection are interesting and skillful. Sterilization is by boiling. Cavernous angiomas and metastatic melanomas may require the embedding of needles, which become encysted and cause no harm, or slough out if the surface is infected. E. W. R.

The Rentgenographic Study of the Accessory Sinuses, With Special Reference to the New Technique for the Examination of the Sphenoid Sinuses. George E. Pfahler, Philadelphia. Annals of Otol. Rhin. and Laryng., p. 380.

DUE to the fact that the sinuses contain air, the roentgen examination is very satisfactory. Size, outline, position, and the condition of the walls and the septa can be demonstrated. Exudate can be determined, but pus, mucus and blood cast the same shadows. Bone changes are demonstrable. By comparison with the corresponding side, differences are noted. The normal must be kept in mind if both sides are affected. A poor plate may appear abnormal. If all sinuses are abnormal, the detail of the skull must be used for comparison. Absence of sinuses will appear differently than sinuses opaque from disease. There is no better way to determine the condition of the ethmoids To the rhinologist the great advantage is to locate the exact size, the septa, and the exudate.

Tumors of the sinus are either primary or secondary. If primary, they are usually sarcoma. In addition to exudate, there is always a destruction or expansion of the walls of the sinus.

All the sinuses should be examined. Three antero-posterior views are obtained with the patient lying down. The first view is made by directing the vertical ray at an angle of 35 degrees with the plane of the gabella and the external auditory meatus. The second passes through a line connecting the external auditory meatus and the external canthus. The third view is taken with the central ray passing immediately below the level of the mastoid process and directed toward the maxillary sinuses. These views show best the frontals, sphenoids, ethmoids, and maxillary sinuses. Lateral views are also made, either flat or stereoscopic. It is important to get the depth and thickness of the frontals.

Dissatisfaction has been expressed with the ordinary methods for demonstrating the sphenoids. To obviate this a new method has been devised. Films are placed in the mouth, backward against the pharynx. Only the outlines of the sphenoid sinuses are obtained; all extraneous shadows are avoided. The films must be cut to fit the mouth and pharynx, about 2 by 3 inches, square at one end and curved on the side fitting the pharynx. To obviate secondary radiation and hard rays, double screens and metal beneath the film are used. A special carrier has been devised to make this posible. The patient sits with the chin on the head-rest. The target distance to the top of the head is 18 inches. A 3-inch cylinder is used, a 4-inch spark gap, and an exposure of 8 seconds, with 30 milliamperes.

The roentgenogram produced demonstrates the outline and size of the sphenoid sinuses side by side, the septa, and exudate if present. The ethmoids may be seen also. This technique in conjunction with the antero-posterior positions gives accurate and satisfactory evidence of the sphenoids. E. W. R.

Further Report on the Use of Radium, the X-Ray and Other Nonsurgical Measures, Combined With Operations About the Head and Neck. Joseph C. Beck, Chicago. Annals of Otol, Rhin. and Laryng., June, 1921, p. 425.

SINCE 1904 several papers have been presented on the same general subject and the same treatment with uniformly poor results. The following list of pathologic conditions about the head and neck are carefully reported case by case, numbering in all sixty-two. They are:

1. Carcinoma, epithelioma, adenocarcinoma
2. Sarcoma
3. Endothelioma
4. Papilloma
5. Angioma
6. Lymphangioma
7. Fibromyxoma
8. Neuroma
9. Chloroma
10. Fibroma
11. Adenoma
12. Lymphoma
13. Lipoma
14. Cystoma
15. Epulis
16. Osteoma
17. Verruca
18. Rhinophima
19. Leukoplakia
20. Paraphinoma
21. Syphiloma
22. Keloid
23. Tuberculoma
24. Exostosis and osteitis
25. Hematoma
26. Abscess

The forms of treatment employed were:

1. Surgical.
3. Radium (surface and deep).
2. X-ray (surface and deep).
4. Surgical diathermia.
5. Cautery.
6. Lysins and chemotherapy.

Conclusions

Comparing his cases before radium and x-ray treatment were in vogue, there was a higher percent of cures.

In order to determine the toxemia in the blood following the radiation of malignant disease, certain investigations are being made. There is a difference between this intoxication and that produced by the rays acting on normal tissue.

The earliest posible diagnosis of malignant disease with thorough early operation, without x-ray or radium treatment either before or after operation, would be to the best interest of the patient.

The greatness of x-ray and radium in the possibility of curing malignancy is recognized, but it has not been demonstrated by sixteen years of experience. However, the effort to cure malignancy by these means will go on.

Following up and reporting cases is of the most importance.

In nonmalignant conditions every effort should be made to determine the value of x-ray and radium, because there is much to gain and nothing to lose.

There is no question but that radium is the method of choice in treating angiomata. In eighteen cases results were uniformly good.

E. W. R.

Radium Plugs for the Dissolution of Orbital Gliomatous Masses Developing After Excision of the Globe. Burton Chance, Philadelphia. Amer. Jr. Ophthalmology, September, 1921.

THIS case was reported in June, 1921, and is still alive. In a condition apparently hopeless the eyeballs were excised in November, 1920. Following the removal of a gliomatous mass there was a recurrence of the malignancy. In the recurrent mass tubes of radium encased in non-corrisive steel were buried. Each contained 10 mg. of radium sulphate. In the left orbit he inserted nine of these tubes, in the right five small tubes and one large. These were left in for twenty hours.

Radium emanations were not used, as they have been found uncertain in action. The radium salt permits the entire radiant effect when buried. If applied to the outside, one-half of the effects are lost.

There is no personal knowledge of recoveries from this condition, but this patient, only four years of age, is alive and apparently well, without signs of recurrence.

E. W. R.

The Radium Treatment of Goiter. D. T. Quigley, Omaha. The Medical Herald, Sept. 1921, p. 225.

THE following group of cases have gone over a year since receieving treatment:

Kind	No. Cases	Improved	Cured	Dead	Not Improved
Simple	7	4	1	1	1
Exophthalmic	23	14	12	1	0
Malignant	3	0	1	2	0

..The table is self-explanatory. The results were prompt and decisive. There was no shock or risk of operation. Primary ligation should be dispensed with in favor of radium treatment. Na patient with simple or toxic goiter should be submitted to operation without first being given the benefit of radium treatment.

Radium-X-Ray Therapy of Carcinoma Uteri and Uterus Bleeding. Frank S. Bissell, Minneapolis, Minnesota Medicine, June, 1921.

Radium and roentgent ray have been accepted in the treatment of malignancy. Surgeons now often advise substitution of it for operation. Even the best operators show a high operative mortality rate. The most careful statistics give a clinical cure of but 3 to 10 per cent. of all cases presenting themselves, a high immediate mortality, and so many disagreeable sequelae that there is but little to justify its continued employment.

In radiation therapy all cases can be treated; there is no operative mortality. The local disease can be eradicated and the metastases attacked. Statistics cannot be safely quoted be-

cause the use has been too recent and the technique changing. Yet the literature is full of cures reported, relief obtained. The future is promising for improvement.

The inoperable and hopeless cases are improved without discomfort or shock. Bleeding and foul discharges cease. There is assured a period of improvement, and in the end a shorter and less painful death.

The combined surgical and radiation therapy has been generally followed. Time will tell the value of it. Preoperative radium combined with roentgen therapy should be used in many more cases. This destroys and inhibits the cell activity. Operative wounds may be used at times for placing radium nearer the cancer source.

An operator should not touch a case unless he can remove all of the cancer mass. Fulgerating a mass to destroy a part of it accomplishes no purpose. Radium will do as much. Case reports show bad effects from combined surgical and radiation therapy.

Also, some reports show excellent results from radium and x-ray combined.

Microscopic studies show the action of radiation to be due to the inhibition of cell proliferation. The function of cell reproduction ceases and round cell infiltration follows, replaced in time by dense scar tissue. Nests of typical cancer cells may remain included in the sclerotic tissue and under proper conditions again become active. To combat this danger of recurrence, six months of active treatment and a period of rest should be followed again by intensive treatment.

The word cure for cancer of the cervix should not be used. Symptomatic cure is more applicable. Sufficient time has not elapsed.

Statistics accumulating are encouraging. Scherer and Keley have treated 218 cases with x-ray and radium, and they estimate 10.5 per cent. greater success than in operation.

Bumm reports 108 cases, five inoperable, and recurrences to date of but 15 cases. Doderlein reported symptomatic cures in 31 out of 153 cases. Twelve of these had been classified as inoperable.

There is much justification for substituting radiation therapy for surgery, but the roentgenologist is loath to assume the responsibility alone. But he insists that in all cases in which both are used, intelligent radiatio ntherapy be followed.

Conclusions

Combined radium and x-ray therapy is the treatment of choice in all cases of cancer of the cervix.

In early cases, conservative surgery followed by radiation is justifiable, but probably the latter alone will prove equally efficient.

In carcinoma of the fundus surgical results have been so good that these cases should all be submitted to operation. As in all other cancer cases, however, the patient should be given the added benefit of post-operative radiation.

Radiation should be accepted as a specific in the menorrhagia due to myoma or fibrosis or those of unknown etiology.

E. W. R.

Linitis Plastica. E. P. Palmer, W. W. Watkins and H. P. Mills, Phoenix, Arizona Surgery, Gynecology & Obstetrics, September, 1921.

LINITIS Plastica under many names has been known since 1854, when Brinton first studied it. It affects any part of the intestines, chiefly the stomach. There is a thickening of all the walls, but mainly the submucous connective tissue, with atrophy of the mucous membrane. Slow stenosis occurs in the stomach, with the most marked change at the pylorus. A tumor in the epigastric region with symptoms of food stagnation and the absence of pain, hemorrhage and early vomiting, characterize clinically the disease.

There are two forms, localized and diffuse. It is also classified as benign or malignant. Morrison states that 50 per cent. of the cases are malignant. It occurs in adults only between forty and sixty years, and about twice as often in men as women.

The histopathology is that of sclerosis, and in all probability it is malignant, although there is much dispute concerning this point.

Linitis plastica resembles scirrhous carcinoma and chirrotic syphilis of the stomach, and frequently has been mistaken for both. In linitis plastica the onset is slower and the symptoms less severe; in fact, there are few until stagnation occurs. Carcinoma is more rapid and severe in its course. Pain, vomiting and hemorrhage are usually greater.

Syphilis occurs in younger patients, and a history or the Wassermann help to differentiate it.

The roentgen examination offers the best means of recognizing the lesion, although it may be difficult to exclude carcinoma or syphilis.

The roentgen ray characteristics are those of a filling defect with a relatively smooth inner margin and with peristalsis absent from the area involved. The pylorus may be either gaping or obstructed. On the fluoroscopic screen the stomach is small and drawn upward. It lacks expansibility. Early obstruction may occur in which the stomach becomes dilated. It may take the microscopic examination to tell the real pathology.

The treatment is surgical only. Gastrectomy is advisable and has given satisfactory results.

E. W. R.

The Crystalline Lens. Drs. Cohen and Levin. Ophthalmic Literature, p. 146, June, 1921.

TWENTY-FOUR cases on radium treatment of cataracts are reported. Only the gamma rays were utilized, all the others being filtered off. Brass, photographic paper and guaze were used for filters. The radium came within two centimeters of the eyelid. The application lasted about two hours.

The authors conclude that (1) the application of radium to the eye is harmless; (2) the opacity of the lens improves; (3) treatment by radium in nowise interferes with subsequent surgical treatment if necessary; (4) it is desirable to submit a large number of early cataracts to radium treatment.

E. W. R.

Fractures of Transverse Processes of the Lumbar Vertebrae. George F. Davis, Chicago Surgery, Gynecology and Obstetrics, p. 272, Sept., 1921.

FRACTURES of the transverse processes are frequently overlooked. With the improvement in x-ray technique, with the aid of dupletized films, intensifying screens and the Bucky diaphragm, many cases of sprained back are found to be due to fracture of the transverse processes.

Study of the embryology and the anatomy clear up many points in the etiology. Ossifying centers help to determine the lines of fracture in the young. Practically all of them occur from direct violence and are due to the broad attachment of the powerful muscle, the quadratus lumborum. in the majority of the cases reported the age was past thirty-five and the etiology was due almost entirely to the pull of the quadratus upon a fixed spine, pelvis and ribs.

;Backache is the chief symptom. This is persistent, and relieved only by complete relaxation in bed. The disability may be removed in two or three weeks, but it usually continues a long time. Besides, pain, muscular rigidity and localized tenderness are present.

The x-ray examination may show a linear fracture with the fragment in good position. Gross displacement even of ribs may occur. Especially may a lumbar rib be found loose. Osteoarthritis is common. X-ray will of course show the fracture. Many were overlooked before its use and refinement of its use.

Conclusions

Indirect violence plays the most important role in fractures. The occurrence is noted in patients of advanced years, beyond the time when ossific centers play a role. The condition is often associated with osteoarthritis.

E. W. R.

Bone Atrophy: An Experimental and Clinical Study of the Changes in Bone Which Result From Non-Use. N. A. Allison and Barney Brooks, St. Louis Surgery, Gynecology and Obstetrics, Sept., 1921, p. 250.

THE exact nature of bone changes due to non-use is not fully known. Paralysis, inflammation and injury causing non use bring about fragility and more permeability to the roentgen ray. It has been thought that certain trophic changes or inflammation caused these changes. The assumption is that non-use accounts for most of the change, and that it is the architecture of the bone that is changed rather than the tissue itself. Bone should be looked upon as connective tissue in which is laid down an intracellular matrix. The physical qualities are due to the matrix alone. Non-use will slow down the process of bone growth in the young, but will not cause it to cease altogether. The difference between normal growing bone and bone changed by non-use has not been established.

Bone regeneration is a process which must be considered independently of bone growth.

This experimental study was carried out to determine the effect of

non-use of bones as it concerns:

1. X-ray photographs.
2. Gross and microscopic anatomy.
3. Chemical composition.
4. Breaking strength.
5. Growth, and
6. Regeneration.

It was found that the changes in the bones of dogs were identical with the changes in human bones.

In these experiments in which non-use was produced by nerve paralysis, injury to joints and simple fixation, the changes in the bones were the same. The degree of atrophy was in direct proportion to the time of non-use. The rapidity of atrophy was the same for simple fixation as for a nerve injury or injury to the joints. There is no assumption that any disease plays a part other than from non-use. In a patient with ischemic paralysis of a leg there was no evident atrophy after a period of four months.

Bone absorption is an active process and the circulation of the blood is necessary to its progress. The tissue characteristics do not change with atrophy. Only the amount of bone present changes. This affects the size, shape, thickness, length, weight, and accounts for the changes in gross anatomy, x-ray photographs, breaking strength, and chemical composition.

E. W. ROWE.

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Grand Rapids, Michigan
President The Radiological Society of North America, 1921.

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